SCIENCE ABSTRACTS.

Section A.—PHYSICS.

MARCH, 1931.

GENERAL PHYSICS.

695. Precision Stiffness Meter. D. A. Oliver. *Journ. Sci. Instruments,* 7. *pp.* 318–322, *Oct.*, 1930.—A meter suitable for measuring a large variety of stiffnesses is described. Deadweight loading is employed and deflections are measured by screw-gauge, contact being indicated electrically. Its application to a number of problems is pointed out and some typical stiffness measurements are given. AUTHOR.

696. Micromanometer of High Sensitivity. E. Ower. *Phil. Mag.* 10. *pp.* 544–551, *Oct.*, 1930.—Schematically this is a manometer of U-tube pattern, in which the two arms (circular cups 4 in. in diameter) are connected by a capillary tube. The cups are mounted geometrically on a system of levers operated by a standard screw-thread and producing a magnification of 10, whereby their relative heights may be varied by multiples of 0·00001 in. A null system is employed, any difference in pressure being balanced by raising one cup a measured distance relative to the other, using as indicator an air bubble enclosed in the capillary. Provided the latter is horizontal, there is no tendency for the manometric liquid (xylol) to pass between the bubble and the walls of the capillary. Pressure readings accurate to 0·00001 in. of xylol imply an accuracy of ± 1 % in determining air-speeds of 1·5 ft. sec., using the combined pitot-static tube, as compared with a limiting accuracy of ± 1 % on a 6 ft. sec. velocity-head measured with the Chattock gauge. The instrument must be kept at a uniform temperature by enclosing in an insulated box. L. V. C.

697. Molecular Volume Relationships in Liquid Mixtures. W. Herz. *Zeits. f. Elektrochem.* 36. *pp.* 850–852, *Oct.*, 1930.—A comparison of the difference between the " true molecular volume " of a liquid mixture calculated from the molecular refractions of the mixture and that calculated from those of its components, with the difference between the molecular volumes observed from measurements of the density of the mixture and its components. Divergences from an additive relationship indicate expansions or contractions. The differences can have the same, although they very often possess opposite, signs, and either vary uniformly with composition of the mixture or pass through a maximum. The calculations are also extended to aqueous salt solutions. C. B. A.

698. General Theory for Calculating Surface Tension from Shapes of Stable Liquid Surfaces of Revolution. B. B. Freud and H. Z. Freud. *Science,* 72. *pp.* 435–436, *Oct.* 24, 1930.—The theory, based on numerical solutions of Laplace's equation, $du/dx + u/x = 2(h \pm y)$ permits the construction of curves showing the shapes of stable liquid surfaces of three main types, described as meniscus, disc and drop profiles. Detailed working-out for the first two types has been applied to the " ring method " [see Abstract 3307 (1930)], and, for a third, to the shape of stable pendant drops [see Abstract 439 (1930)]; the analytical results are in accord with those obtained by direct experiment, and the corresponding experimental methods may now, therefore, be deemed absolute. L. V. C.

699. Surface Tension of Soap Solutions and its Relation to the Thickness of Adsorbed Films. R. Bulkley and F. G. Bitner. *Bureau of Standards, J. of Research,* 5. *pp.* 951–956, *Oct.,* 1930.—A sharp minimum in the surface tension-time curves of certain soap solutions has been interpreted in the literature as indicating the gradual formation of a surface film possessing the properties of a plastic solid and having a thickness equivalent to some 10,000 molecular lengths. In this paper the hypothesis is advanced that the formation of the thick film is brought about by chemical action between carbon dioxide from the air and dissolved soap. Surface-tension experiments performed in the open air have confirmed the existence of the minimum point observed by previous investigators. However, when solutions prepared in exactly the same manner were tested by the same method in an atmosphere free from carbon dioxide no minimum point was found. The solutions behaved instead in the manner which is characteristic of colloidal solutions in general. These results support the hypothesis advanced above and leave the preponderance of evidence against the existence of a film of extraordinary thickness at the surface of soap solutions. AUTHORS.

700. Effect of Temperature on the Viscosity of Air. W. G. Shilling and A. E. Laxton. *Phil. Mag.* 10. *pp.* 721–733, *Oct.,* 1930.—Certain modifications were made to the apparatus used by Williams [see Abstract 1193 (1926)] in this problem, on account of criticisms made by Rankine. Observations have been made by the same comparative transpiration method over the temperature range 23°–850° C. The method has been completely vindicated. There is a small but steady deviation from Sutherland's law over this range. It is suggested that the peculiar results obtained by Williams are due to his method of smoothing experimental values. See also **A. O. Rankine,** *ibid.* 11. pp. 225–227, Jan., 1931. H.N.A.

701. Variation of Flow Conditions and Determination of Corresponding Water Level. A. A. Marchetti. *Univ. Nac. La Plata, Contrib. No.* 91. *pp.* 157–181, *Sept.,* 1930.—The relationship between the depth and head of a current of water is developed, and the result is applied to the calculation, for both turbulent and tranquil flow, of the alteration of the normal level produced by irregularities of the bed. The rate of flow at constant head as a function of depth is considered, and the graphical presentation of the flow line is described, together with its application to the calculation of the conditions governing tranquil and turbulent flow. Illustrations are given of the determination by the graphical method of the change of flow conditions caused by the presence of an obstacle in the current. H. F. G.

702. Steady Flow with Isolated Vortices. R. Mazet. *Comptes Rendus,* 191. *pp.* 600–602, *Oct.* 13, 1930.—The method of conformal representation is employed to discuss the two-dimensional flow of fluid in a polygonal channel, turbulence being produced at one point by two adjacent walls jutting out into the fluid thereat. The theory is applied to the flow of fluid in a rectilinear channel wherein the cross-sectional area is suddenly and symmetrically increased at one point by means of symmetrical walls, normal to the direction of flow in the channel on either side of this discontinuity. **Errata**, *ibid.* p. 372, Nov. 17, 1930. J. S. G. T.

703. Flow in a Channel. H. Poncin. *Comptes Rendus*, 191. *pp.* 648–651, *Oct.* 20, 1930.—In two previous papers [see Abstracts 3313 and 3916 (1930)] the author has derived the principle of a method permitting the study in certain cases of liquid motion in a vertical plane. In order to show how the theoretical results may be utilised in practice, the present mathematical paper deals with the important case of a canal possessing an abrupt change of level. H. H. Ho.

704. Surface Oscillations of Water in a Rotating Cylindrical Vessel. R. O. Street. *Cambridge Phil. Soc., Proc.* 26. *pp.* 446–452, *Oct.*, 1930.—The author is concerned only with " short waves " and deals in particular with the effect of depth. It appears that there will be two waves, one travelling relative to axes rotating with the fluid, in a direction opposite to that of the rotation, and the other in the same direction as the rotation, the period for any particular mode of vibration being greater for the latter wave. Increase in the depth of the water causes a decrease in the period of any particular wave, whilst at the same time the periods of the two waves of any given mode tend to become equal. The effect of small deviations from circularity in the cross-section of the cylinder is investigated and found not to affect the periods of the oscillations. W. S. S.

705. Origin of Water Waves. H. v. d. Borne. *Gerlands Beitr. z. Geophys.* 28. 1–3. *pp.* 55–58, 1930.—The action of wind in producing ripples on water with wave-lengths up to 60–70 cm. and requiring a wind speed not less than 20 m./sec. can be explained by using the Helmholtz theory. Viscosity increases the wave-length of water waves and the orbital velocity of the water particles. The magnitude of the viscosity is expressed in the form

$$R = 8\eta\sqrt{\frac{\pi g}{2\lambda}} \cdot \rho \sqrt{\left(\frac{2\pi}{\lambda}\right)^2 + \left(\frac{1}{\frac{\lambda}{2\pi} + \rho}\right)^2}$$

This produces a continuous decrease of viscosity as wave-length increases, but the increase of wave-length becomes slower and slower. Eventually the shorter waves overtake the longer waves, and a superposition results when the wave-lengths become equal, viscosity being the cause of growth from ripples to large waves. R. S. R.

706. Relation between Mass Transfer (Absorption) and Fluid Friction. A. P. Colburn. *Indust. and Engin. Chem.* 22. *pp.* 967–970, *Sept.* 1, 1930.—In processes such as absorption of soluble gases and dehumidification, the rate of mass transfer is dependent on the rate of diffusion of molecules through a viscous gas film adjoining the liquid surface and on eddy currents in the turbulent portion of the gas stream. An equation is derived for mass transfer from fluids in turbulent motion which is based on resistances in both the viscous film and the turbulent core similar to the method used by Prandtl and by Taylor in obtaining a relation between fluid friction and heat transfer. The resulting equation is $K = \frac{(f/2)M_v G}{P_{gf} M_m \Phi}$, where K = mass transfer coefficient, f = friction factor, G = mass velocity, P_{gf} = logarithmic mean partial pressure of non-condensable gas in the film, M_v = molecular weight of solute gas M_m = mean molecular weight of gas mixture, and Φ = a function of gas properties and flow conditions which usually has a value of nearly unity. Agreement is shown with experimental data for both dehumidification and absorption. AUTHOR.

707. Resistance and Buoyancy Wing Profile with Favourable Pressure Distribution at the Surface. F. Weinig. *Zeits. f. techn. Physik*, 11. 12. *pp.* 538–544, 1930.—The properties of the hodograph of the air current about the profile of an aeroplane wing are described and the method given for finding the profile from the hodograph. By this means profiles can be derived for currents of given characteristics. The paper is replete with diagrams. H. H. Ho.

708. Studies in Diffusion. J. H. Arnold. Part I. Gaseous Systems. *Indust. and Engin. Chem.* 22. *pp.* 1091–1095, *Oct.*, 1930. **Part II. Liquid Systems.** *Am. Chem. Soc., J.* 52. *pp.* 3937–3955, *Oct.*, 1930.—In Part I methods are given for the calculation of diffusion constants in gaseous systems at any temperature, using as basis the Stefan-Maxwell-Sutherland formula from the kinetic theory of gases. The molecular diameters required for the evaluation of this expression are calculable in terms of the liquid molecular volume at the boiling point, found by Kopp's law. A method of calculating the Sutherland constant for diffusion from the boiling points and molecular volumes of the constituent substances is described. The basic equation is applied to the available data on the diffusion of gases and vapours and found to be in good agreement. These methods of estimation are believed valid for all gaseous systems and are of especial value for engineering purposes, as they require a knowledge of only the molecular formulæ and the boiling points of the substances involved. The equations for determining the diffusion coefficient (in sq. cm. per sec.) may be summarised in the form

$$D = \frac{0{\cdot}00837\sqrt{\frac{1}{M_1} + \frac{1}{M_2}}}{(V_1^{1/3} + V_2^{1/3})^2}\left(\frac{T^{5/2}}{T + C}\right) \quad \text{and} \quad C = F\sqrt{C_1 C_2} = 1{\cdot}47F\sqrt{T_{B_1} T_{B_2}},$$

where V is the molecular volume (sum of atomic volumes) at the boiling point, C the Sutherland constant, F a factor depending on the ratio $V_2 : V_1$, T the absolute temperature, and T_B the absolute boiling point. In Part II the classical kinetic theory of gases is applied to diffusion in liquid systems, on the assumption that the resistance to diffusion is due wholly to binary collisions, and that the shortening of the mean free path due to the volume occupied by the molecules is the same for all systems. Allowance is made for the retarding effect of intermolecular forces by introducing a factor F, which is found empirically to be essentially independent of the nature of the diffusing substance and directly proportional to the square root of the solvent viscosity. Associated substances are found to require the use of abnormality factors in the expression for F. The usual hypothesis of molecular association is incapable of explaining the diffusional behaviour of such substances, and the related hypothesis of solvation of certain substances is unnecessary for good agreement with theory. The variation of diffusivity with temperature is discussed, and various rules are given for the prediction of temperature coefficients. Comparison of the observed diffusion coefficients with those calculated from the theory shows good agreement over a wide range of molecular weights and viscosities. T. H. P.

709. Cohesion of Quartz Fibres. G. A. Tomlinson. *Phil. Mag.* 10. *pp.* 541–544, *Oct.*, 1930.—A reply is given to comments made by Stone [see Abstract 2996 (1930)] on the author's previous work on this subject [see Abstract 371 (1929)]. Experiments on the cohesion of quartz fibres are repeated (1) in an enclosed vessel through which carefully dried air is circulated, (2) in an evacuated vessel, in which the fibres may be heated above 140° C. during the experiment. In both cases cohesion readily occurs, though it is destroyed by contamination with moist air; hence the effect is not due to the surface tension of liquid films on the fibres, as Stone suggested. True cohesion is shown also by the production of tenacious metallic films by rubbing a sheet of glass with a soft metal. L. V. C.

710. Forced Vibration of an Elastic Rod. S. Higuchi. *Imp. Acad. Tokyo, Proc.* 6. *pp.* 306–309, *Oct.*, 1930.—A solution of the problem is obtained from which the state of the rod may be determined not only initially but subsequently. The general case treated is the flexural vibration of an elastic rod of given length, subjected to internal resistance, clamped at one end with a body of given mass attached to the free end, under a given external force acting at the clamped end. H. H. Ho.

711. Stability of Moving Systems. M. Schuler. *Phys. Zeits.* 31. *pp.* 849–856, *Oct.* 1, 1930.—Endeavours to clear up the differences between mathematicians and technicians. Proposes a new definition of stability as follows: " A position (velocity, acceleration) is dynamically stable when after an infinitely small disturbance the disturbed differs from the undisturbed position (velocity, acceleration) by an infinitely small quantity even after an infinite time." Applies this definition to the position of the earth in its orbit, and other cases. E. E. F. d'A.

712. Liouville and Stäckel Integrations of Mechanical Problems. V. S. Vrkljan. *Zeits. f. Physik*, 65. 3–4. *pp.* 280–284, 1930.—Continuing the investigation of a previous paper [see Abstract 2075 (1930)], it is now shown that any mechanical problem in *two* degrees of freedom if integrable by Stäckel's method is also integrable by Liouville's method. The similar theorem for more than two degrees of freedom is not valid. W. S. S.

713. Bonded and Free Systems of Points. E. Gugino. *Accad. Lincei, Atti*, 12. *pp.* 307–312, *Oct.*, 1930.—Discusses the limitations of Lagrange's treatment of holonomous, and of Maggi's treatment of non-holonomous systems. Shows how to reduce the dynamical problem of a bonded system to the analogous problem for a free system. A. D.

714. Finite Deformations of Continuous Systems. A. Signorini. *Accad. Lincei, Atti*, 12. *pp.* 312–316, *Oct.*, 1930.—Mathematical. The first of a promised series of papers containing a revision of the theory of continuous systems with reversible transformations, and more particularly of elastic systems. A. D.

715. Rigid Motion in Generalised Space. Angelina Cabras. *Accad. Lincei, Atti*, 12. *pp.* 316–321, *Oct.*, 1930.—Studies and traces out the conditions introduced by the rigidity of a motion in generalised space. The Euclidean is a limiting case. A. D.

716. Plastic Limit of Polycrystalline Aggregates. J. Dejmek. *Zeits. f. Physik*, 65. 1–2. *pp.* 139–144, 1930.—Mathematical treatment extending the work of v. Mises [see Abstract 2910 (1928)] dealing with the single crystal to the polycrystalline state. The experimental results of Rosbaud and Schmid for zinc are used in working out a numerical example. W. H. GE.

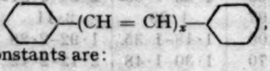
717. X-Ray Investigations of the System Sulphur-Selenium. Part I. Rhombic Mixed Crystals of S and Se. F. Halla and F. X. Bosch. *Zeits. f. phys. Chem.* 10. *Abt. B.* 2. *pp.* 149–156, *Oct.*, 1930.—Rhombic mixed crystals of the system S-Se in various concentrations of the components have been subjected to X-ray analysis of the (111) plane. Information is also given for density, interfacial angles and axial ratios. Considerable deformation of the atoms in the lattice is found, since the effective radius ratios are not constant. The sulphur is thought to exist in activated form. F. I. G. R.

718. X-Ray Diffraction and Structure of Vitreous Solids. J. T. Randall, H. P. Rooksby and B. S. Cooper. *Zeits. f. Krist.* 75. 3–4. *pp.* 196–214, *Oct.*, 1930. *In English.*—X-ray diffraction patterns have been obtained for various vitreous solids by means of Cu-Kα (some also with MoKα) radiation. Bands and peaks were determined with a Moll photometer, and intensities and size of crystallites thence deduced. Vitreous silica shows an intense band at 4·33 Å., and a faint one at 1·5, thus disagreeing with the results of other observers. It probably consists of crystallites of cristobalite, about $1 \cdot 5 \times 10^{-7}$ cm. long, containing about 20 molecules each. The spacing in the (111) plane is 6·6 % greater than that of normal powdered crystals of cristobalite, which fact is qualitatively in agreement with the lower density of the glass. Heat treatment at 700° for 30 min. indicates that there are at least two sizes of crystallites present. Wollastonite glass consists of crystallites $1 \cdot 6 \times 10^{-7}$ cm. long of hexagonal pseudo-wollastonite; borax glass of crystallites of $Na_2B_4O_7$, 10^{-6} to 10^{-7} cm. long. Fused potash and soda felspars show only crystallites of cristobalite, as also does a borosilicate glass (70 % SiO_2, 17 % B_2O_3). The crystallite theory of glass is consistent with its melting and electrolytic phenomena. Amorphous substances generally may be regarded as built up of crystallites. C. A. S.

719. Dependence of Crystal Spacing upon Crystal Size. J. E. Lennard-Jones. *Zeits. f. Krist.* 75. 3–4. *pp.* 215–216, *Oct.*, 1930. *In English.*—The usual expression for the potential of an atom in a crystal lattice (supposed cubic) due to all the rest refers to a crystal of infinite size. The summations need to be replaced by finite summations if the crystal is considered to be limited. If the closest distance between atoms is ϵ (infinite) and ϵ^* (finite), then for non-ionic lattices and a small crystal (about 500 atoms) ϵ^* is about 15 % greater than ϵ. For a crystal 5 layers thick each way the expansion amounts to about 7 %, and for 3 layers about 14 %. The case of argon shows that for these non-ionic types the total attractive field diminishes relative to the total repulsive field with decreasing particle size, whereas with typically ionic lattices like NaCl the reverse holds. Argon thus shows an increase of some 30 % in the transition solid → molecule, while NaCl exhibits a decrease of about 18 % for the same process. F. I. G. R.

720. X-Ray Determination of the Form and Boundary Surfaces of Ultramicroscopic Crystals. R. Brill. *Zeits. f. Krist.* 75. 3–4. *pp.* 217–227, *Oct.*, 1930.—The method furnished by Laue's calculation for determining the form and boundary surfaces of ultramicroscopic crystals is discussed and the results given of the application of such method to a highly disperse electrolytic nickel. The particles are found to have the octahedral planes as principal boundary surfaces and to have a length three times their breadth or thickness. The bearing of these results on the process of crystal formation during electrolysis is considered. T. H. P.

721. Stereochemistry of Crystalline Compounds. Part II. Complex Compounds A-B. Part III. Inorganic Compounds. P. Niggli. *Zeits. f. Krist.* 75. 3–4. *pp.* 228–264, *and* 75. 5–6. *pp.* 502–524, *Oct.*, 1930.—The considerations previously advanced refer to compounds AB in which both A and B are mono-atomic [see Abstract 31 (1931)]. A similar discussion is now given for compounds in which either A or B represents a polyatomic radical with a central atom, *e.g.*, SO_4, ClO_3, or NH_4, such compounds being expressed in the form $A[BX_n]$ or $[AX_n]B$. Two possibilities arise: either $[BX_n]$ or $[AX_n]$ forms a structural island, or every X belongs, in regard to its space relations, to several B's or several A's. In each case it is easy to determine whether, for any given n, substitution is geometrically possible without alteration of the total symmetry. A crystal compound of this kind is termed perfectly system-symmorphic if A and B assume system-symmorphic positions and the X-atoms do not disturb this symmetry. The structures of a large number of compounds are discussed from this point of view. In Part III the structures of compounds like silicates, borates and aluminates are considered. T. H. P.

722. X-Ray Examination of Diphenylpolyenes. J. Hengstenberg and R. Kuhn. *Zeits. f. Krist.* 75. 3–4. *pp.* 301–310, *Oct.*, 1930.—An X-ray examination by the rotating crystal method, including the use of moving film technique, is made of the homologous series of diphenylpolyenes , where x varies from 2 to 7. The lattice constants are:

	x	a	b	c	Density.	Space-Group.
Diphenylbutadiene................	2	7·71	11·70	13·31/sin β ($\beta = 97°$)	1·138	C_{2h}^2
Diphenylbutadiene hexatriene	3	6·33	7·43	14·43	1·139	C_{2h}^5
Diphenylbutadiene octatetraene	4	6·25	7·44	16·03	1·144	?
Diphenylbutadiene decapentaene ...	5	10·25	7·66	21·2	1·152	V_h^{15}
Diphenylbutadiene dodecahexaene ..	6	10·20	7·60	23·58	1·185	?
Diphenylbutadiene tetradecaheptaene	7	10·2	7·57	25·95	1·130	?

Some molecular symmetry is found directly from the space-group determinations. For the higher homologues the crystal molecule probably consists of two chemical molecules. W. H. Ge.

723. New Twinning Principle in Galena. Twinning Plane (301) or (201). H. Ehrenberg. *Zeits. f. Krist.* 75. 5–6. *pp.* 379–386, *Oct.*, 1930.—A specimen of galena shows the twinning plane (301) or (201), with coincidence of zones [100] and [40$\bar{3}$]. Some of the crystals are formed as skeletons with octahedral terminations. The directions of the skeletons are (301), ($\bar{1}$03) and (010). A. J. M.

724. Crystal Structure of Urea by the Powder Method. R. W. G. Wyckoff. *Zeits. f. Krist.* 75. 5–6. *pp.* 529–537, *Oct.*, 1930. *In English.* The powder method as previously described [see Abstract 1310 (1930)], save for the use of Ni-Kα radiation, has been employed to determine the structure of urea. With no special effort to get the most accurate possible data, results in close agreement with those obtained by Hendricks by means of Laue and spectral photographs have been obtained. The chief features of the reflection range are the high level of general scattering and the rapidity with which the peaks decrease as the reflection angle increases. It is thus shown that this method can be safely used to investigate the structure of simple organic crystals. C. A. S.

725. High Temperature Structure of Perchlorates of Monovalent Elements. H. Braekken and L. Harang. *Zeits. f. Krist.* 75. 5–6. *pp.* 538–549, *Oct.*, 1930.—The structures of the cubic varieties of the perchlorates of sodium, potassium, rubidium, cæsium, ammonium, silver, and (monovalent) thallium have been determined at temperatures above those at which they become cubic, by means of Cr-Kα radiation. All are face-centred, and of space-group T_2^d. The atoms are probably not ionised Results are summarised as follows:

Salt.	Temperature of Observation. °C.	Density Calculated.	Lattice Constant. Å.	Cl-O. Å.	O-O. Å.	Apparent Radius of ClO_4 Group. Å.
$NaClO_4$	314°	2·26	7·08	0·85	1·39	2·56
$KClO_4$	310°	2·15	7·50	1·26	2·06	2·42
$RbClO_4$	300°	2·66	7·70	1·30–1·48	2·12–2·42	2·36
$CsClO_4$	230°	3·00	7·98	1·35–1·53	2·20–2·51	2·34
NH_4ClO_4	243°	1·71	7·67	1·29	2·11	2·41
$AgClO_4$	160°	3·96	7·00	1·18–1·35	1·92–2·20	2·37
$TlClO_4$	280°	4·37	7·70	1·30–1·48	2·12–2·42	2·36

[See also Abstract 2405 (1930).] C. A. S.

726. Estimation of Structure from Acoustic Natural Oscillations. A. Meissner. *Zeits. f. Physik*, 65. 3–4. *pp.* 145–157, 1930.—A continuation of previous work [see Abstract 30 (1928)]. By exciting a quartz disc in a mixture of helium and neon and observing the location of the luminous glow, the angle between the optic axis and the directions corresponding to one of the two observed frequencies (whose ratio is approximately $1 : \sqrt{2}$) can be determined with fair accuracy. The value found for one crystal was 34·5°. From this it is concluded that the crystal structure of SiO_2 is cubic. The positions of the oxygen atoms in the lattice may probably be found by consideration of the polarity of the elementary cell and also of the size of the lattice. It is shown that the elementary cell, the smallest geometric unit in the structure of quartz, possessing the same symmetry as the macroscopic crystal, contains three molecules of SiO_2 in different planes, three dipoles, whose relative positions and ties give quartz its physical properties. The results obtained from acoustic measurements are confirmed and amplified by measurements with X-rays. The results of X-ray measurements show that two natural oscillations should exist in quartz with a frequency ratio of $1 : \sqrt{2}$, that the structural plane corresponding to the higher frequency makes an angle of 37° with the optic axis, the angle for the lower frequency being about 58°. Certain dimensional relations between the observed acoustic oscillations and the residual rays for quartz are also indicated.

A. W.

727. Photographic Method of Determining Atomic Structure Factors. D. K. Froman. *Phys. Rev.* 36. *pp.* 1330–1338, *Oct.* 1, 1930.—The intensities of X-rays reflected from powdered crystals of magnesium oxide and potassium chloride were measured photographically. It was found that this method made possible the measurement of somewhat higher orders of reflection from powdered crystals than have been determined by the ionisation method. The radial electron distribution for each of the atoms was determined and the results indicate that both compounds form polar crystals. AUTHOR.

728. Extrapolation of Atomic Structure Factor Curves. D. K. Froman. *Phys. Rev.* 36. *pp.* 1339–1343, *Oct.* 15, 1930.—An approximate extrapolation formula for atomic structure factors of high order has been deduced from the form of the electron distributions indicated by the wave equation. The result is compared with the structure factors determined from Hartree's electron distribution for $Na+$ [see Abstract 1170 (1928)]. The agreement is good enough to warrant the use of the formula in extrapolating experimentally determined structure factor curves. It is shown that an analogous treatment can be applied to the " S " curves obtained from the scattering of X-rays by gases. AUTHOR.

729. Periodic System. Part III. Relation Between Ionising Potentials and Ionic Potentials. G. H. Cartledge. *Am. Chem. Soc., J.* 52. *pp.* 3076–3083, *Aug.*, 1930.—The ionic potential ϕ_v defined by the relation $\phi_v = z/r$, where z is the charge on the ion and r its radius in a crystal, has been compared with the ionisation potential V. It is shown that Δ_v which is equal to $\phi_v - 2V$ is given by the empirical equation $\Delta_v = a\phi_v^b$, where a and b are constants. Evidence is brought forward to show that Δ_v/ϕ_v may be taken as a measure of the polarisability of an ion. [See also Abstract 698 (1929).] F. J. W.

730. Polarisability of the Helium Atom and the Lithium Ion. H. R. Hassé. *Cambridge Phil. Soc., Proc.* 26. *pp.* 542–555, *Oct.*, 1930.—The method employed was suggested to the author by Lennard-Jones, and was used by London and Eisenschitz to calculate the interatomic force between two hydrogen atoms [see Abstract 2688 (1930)]. The author shows how the polarisability of atomic hydrogen by a small external electric field can be calculated. The result is known from the calculation of the second order Stark effect. Here the undisturbed wave function ψ_0 is accurately known, but this is not the case for helium, where ψ_0 is only given analytically to a certain degree of approximation.

Helium is considered in detail, and the final estimate for the polarisability is $\alpha = 0{\cdot}206 \times 10^{-24}$, with a possible addition of $0{\cdot}001 \times 10^{-24}$, which is in very good agreement with the experimental value. The same problem for the lithium ion only requires a simple extension of the previous analysis. The result is $0{\cdot}0313 \times 10^{-24}$. This does not agree very well with the values of Born and Heisenberg, and of Fajans and Joos; but the value calculated from the polarisability of helium, on the basis of Bethe's values of the average distance of the electronic charge for He and Li^+, is $\alpha = 0{\cdot}042 \times 10^{-24}$ for Li^+. H. N. A.

731. The Proton. P. A. M. Dirac. *Nature,* 126. *pp.* 605–606, *Oct.* 18, 1930. *Paper read before the British Assoc., Bristol, Sept.,* 1930.—The author sketches in general terms his theory of the proton. The latter is identified with an unoccupied electronic quantum state of negative energy, the great majority of such states being occupied. The motion of the proton in an electromagnetic field is then the same as the motion of an electron with the negative energy corresponding to the unoccupied state in question, this result following from the Dirac wave equations of the electron. Among the difficulties of the theory, the unobserved existence of an infinite density of negative-energy electrons, in apparent contradiction to Maxwell's theory, can be explained by a reinterpretation of Maxwell's equations. The fact, however, that the probability of mutual annihilation of protons and electrons comes out by theory, to a value far in excess of that consistent with experience, is a serious objection. The difference of mass between proton and electron is another unexplained fact not in agreement with the theory. W. S. S.

732. Self-Energy of the Electron. W. Heisenberg. *Zeits. f. Physik,* 65. 1–2. *pp.* 4–13, 1930.—The quantum electrodynamics as developed by Heisenberg and Pauli [see Abstract 2435 (1930)] is applied to the case of very fast electrons the energy of which is large compared with mc^2 and Mc^2. Since in this case the rest mass of the electron can be neglected, no characteristic electron radius can be concerned in the problem of the self-energy of the electron. The conditions under which the self-energy vanishes are investigated. It appears that the single electron problem could be correctly handled without involving infinite self-energy, if solutions of the electrodynamics in the absence of matter existed with zero null-point energy. Such solutions do not exist, and some change in the fundamental principles of the field theory seems called for. W. S. S.

733. Matrix Mechanics of the Spinning Electron. G. Temple. *Cambridge Phil. Soc., Proc.* 26. *pp.* 496–506, *Oct.,* 1930.—It is shown that in the theory of the operational wave equation developed by the author [see Abstract 3340 (1930)] it is possible to eliminate entirely the wave function, which has served as a passive operand, to obtain a pure "matrix mechanics." Many previous results are obtained with much greater facility by the new method, which is used to obtain the quantum numbers and energy levels of hydrogen-like atoms and to discuss the Zeeman effect in optical doublets. On the other hand, certain problems such as the scattering of electrons by a nucleus seem to demand the use of the wave functions. W. S. S.

734. Ground Term of the Two-Electron Problem for H^-, He, Li^+, Be^{++}, etc. E. A. Hylleraas. *Zeits. f. Physik,* 65. 3–4. *pp.* 209–225, 1930.—Calculates the energy of ionisation of normal helium, and the

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analogous atomic configurations. These problems are combined into a single problem, in which the reciprocal of the nuclear charge is regarded as a perturbation parameter. The expression found for the total energy is $E = Rh\left(-2Z^2 + \frac{5}{4}Z - 0{\cdot}31488 + 0{\cdot}01752\frac{1}{Z} - 0{\cdot}00548\frac{1}{Z^2}\right)$. The first term in this expansion in powers of $1/Z$ is the known first unperturbed energy, the second term is obtained by an ordinary perturbation calculation. The determination of these two terms requires only a knowledge of the characteristic function of zero approximation, *i.e.*, the first term in the corresponding expansion of the characteristic function. The third term can be calculated as accurately as necessary by means of a quickly converging calculation device. This also gives the characteristic function of first approximation, which, however, converges much more slowly. The fourth term also converges very slowly. Practically only the third term is determined theoretically, and the fourth and fifth are only calculated correction terms. The formula agrees well with the accurate spectroscopic determinations of the energy for He, Li^+ and Be^{++}. For H^- there are only uncertain thermochemical data available. H. N. A.

735. Dissociation Formula on Fermi-Dirac Statistics. E. A. Milne. *Roy. Astron. Soc., M.N.* 90. *pp.* 769–778, *Oct.,* 1930. *Supplement.*—The formula for the general condition of dissociative equilibrium is obtained according to the Fermi-Dirac statistics in a simplified form and by the use of first principles only. The formulæ show readily when one or more systems of components of the gas is degenerate or non-degenerate, and reduce immediately to the Saha form when there is no degeneracy. The paper concludes with a determination of the pressure in the gas from the formulæ obtained. The paper is entirely mathematical. G. C. McV.

736. Einstein Bose Statistics. M. Didlaukis. *Zeits. f. Physik,* 65. 1–2. *pp.* 84–87, 1930.—Explains the Bose statistics as a transference of Debye's quantisation of the characteristic vibrations in a hollow space into the corresponding corpuscular state, replacing the distribution of the energy quanta amongst the characteristic vibrations by the distribution of the light quanta in the cells of the Bose phase space. The question whether there is any reciprocal action between light quanta is discussed, and the author decides in the negative. The paper concludes with some remarks on the Einstein gas statistics. H. N. A.

737. Quantum Mechanics Matrix Geometry. K. Nikolsky. *Zeits. f. Physik,* 65. 3–4. *pp.* 273–279, 1930.—Works out certain mathematical relations between the Cayley-Klein parameters, the Dirac matrix system and the Eddington pentades. W. S. S.

738. Indefiniteness in the Quantum Theory. W. Wataghin. *Zeits. f. Physik,* 65. 3–4. *pp.* 285–288, 1930. *Comptes Rendus,* 191. *pp.* 763–766, *Nov.* 3, 1930.—Endeavours to establish new relations of indefiniteness in accordance with the assumptions of Fürth [see Abstract 912 (1930)], in connection with the location of a free electron in the Bohr-Heisenberg experiment by means of the light quanta dispersed by it. Shows that for a particle of mass m the indefiniteness is limited as regards space and time by the relations $\Delta q \gtrsim \frac{h}{mc}$ and $\Delta t \gtrsim \frac{h}{mc^2}$ respectively. E. E. F. d'A.

739. Uncertainty Principle in Quantum Mechanics. R. W. Ditchburn. *Roy. Irish Acad., Proc.* 39. *pp.* 73–81, *Oct.*, 1930.—In discussing the uncertainty principle some confusion occurs in the literature between *probable* and *possible* errors. It is here shown that the term " product of the possible errors " is meaningless and that very misleading conclusions may be drawn, employing the " probable errors." The full significance of the principle is contained in Bohr's probability theorem which states that for the conjugate variables p and q,

$$\psi(q) = \int_{-\infty}^{+\infty} g(p)e^{2\pi ipq/h}dp \quad \text{and} \quad g(p) = \frac{1}{h}\int_{-\infty}^{+\infty} \psi(q)e^{-2\pi ipq/h}dq,$$

where $|\psi(q)|^2$ is the probability of the electron being at the place defined by q, and $h|g(p)|^2$ is the probability of its having a momentum defined by p. If $|\psi(q)|^2$ is a Gaussian error function, the product of the *probable* errors $\Delta p\Delta q$ equals exactly $\frac{h}{4\pi}$, but for all other cases it is greater. The analysis applies strictly to the case when $\psi\bar{\psi}$ is continuous and unrestricted; when $\psi\bar{\psi}$ is restricted to certain ranges it appears that it may be possible for $\Delta p\Delta q$ to be less than $\frac{h}{4\pi}$. W. S. S.

740. Principle of Identity and the Exclusion of Quantum States. G. N. Lewis. *Phys. Rev.* 36. *pp.* 1144–1153, *Oct.* 1, 1930.—It is suggested that a sharp distinction must be drawn between identical particles and those that are only quasi-identical in the sense that they are the same in mass, charge and the potential fields to which they give rise. All results of quantum mechanics obtained hitherto are valid even if it is assumed that two particles such as two electrons or two helium nuclei are only quasi-identical. The postulate of complete identity is a new mathematical condition which operating simultaneously with the wave equation and its boundary conditions gives rise mathematically to a number of exclusion laws such as those obtained empirically. The assumption of identity implies that one portion of the configuration space is merely a reflection of another, and, if the wave function is a scalar, the laws of exclusion are obtained from this notion without ambiguity. Thus a perfectly symmetrical diatomic gas in its simplest electronic state can have only even rotational levels. The theory is extended to the case when the wave function has a vector character corresponding to the spin effect. As example, the problem of the helium atom is discussed.
W. S. S.

741. Rotation Structure of Light Molecules. W. Weizel. *Phys. Zeits.* 31. *pp.* 880–882, *Oct.* 15, 1930. *Paper read before the Deut. Physikertag., Königsberg, Sept.,* 1930.—The author shows how the investigation of rotation band structure yields information about the electron configuration, and in particular renders possible the determination of the electron orbital momentum l in the case of light molecules. For large rotations of the molecule the rotational energy is given by $E_{rot} = B(K + \frac{1}{2} - L)^2$, where K is a single quantum number corresponding to the total angular momentum of the molecule and L represents the quantised component of l with respect to the molecular rotation. By plotting

$$\frac{E_{rot} - B(K + \frac{1}{2})^2}{2B} = -L(K + \frac{1}{2}) + \frac{L^2}{2}$$

against K for different rotation sequences, the values of L are obtainable. For example, in a particular case (He_2) L values $-2, -1, 0, +1, +2$ indicate a *d*-electron ($l = 2$). Using this l decoupling condition, allocation of terms can also be effected for hydrogen, LiH, BeH, and MgH. W. S. S.

742. Rotating Light Quant Model. H. Bauer. *Phys. Zeits.* 31. *pp.* 882–886, *Oct.* 15, 1930. *Paper read before the Deut. Physikertag., Königsberg, Sept.,* 1930.—Fürth's model of a neutron consisting of an electron and a proton separated by the sum of their radii, from which Fürth derived the correct value of the ratio of proton to electron mass [see Abstract 912 (1930)], is modified by assuming the electron and proton to rotate about their centre of gravity, their distance apart being put equal to a constant × the wave-length of the light to which the neutron or light quant corresponds. Details of the model are worked out in particular for the case when the linear velocity of the electron equals the velocity of light. It appears that light quants of all wave-lengths would have the same angular momentum which in the special case just mentioned would equal the angular momentum of the hydrogen atom in the ground orbit multiplied by the fine structure constant $\alpha = 2\pi e^2/hc$. W. S. S.

743. Dirac Wave Equation of the First Order with Two Components. E. Reichenbächer. *Phys. Zeits.* 31. *pp.* 886–888, *Oct.* 15, 1930. *Paper read before the Deut. Physikertag., Königsberg, Sept.,* 1930.—Discusses in general terms the two-component wave equation of the first order, put forward by the author [see Abstract 925 (1930)], and compares it with the Dirac four-component wave equation. It is suggested that the two-component equation may make possible an explanation of the difference of mass between electron and proton, the general idea being that one wave function would apply to the electron, the other to the proton. Difficulties of the two-component equation are also indicated. W. S. S.

744. Wentzel-Brillouin-Kramers Approximate Solution of the Wave Equation. L. A. Young and G. E. Uhlenbeck. *Phys. Rev.* 36. *pp.* 1154–1167, *Oct.* 1, 1930.—The approximate solution of the one-dimensional wave equation $\frac{d^2\psi}{dx^2} + Q^2(x) \,.\, \psi = 0$, where $Q^2(x) = \frac{8\pi^2 m}{h^2}(E - V(x))$, is obtained by substituting for ψ the expression

$$\psi = \exp\left\{\frac{2\pi i}{h}\left(S_0 + \frac{h}{2\pi}S_1 + \frac{h^2}{4\pi^2}S_2 + \cdots\right)\right\}$$

where S_0, S_1, etc., are functions of x to be determined. It is shown that this method forms a link between Bohr's quantum theory and the new quantum mechanics. It leads to quantisation by the classical phase integrals with the use of half-integral quantum numbers. The method is applied to the charged shell atom model. W. S. S.

745. Electricity, Ether and Quanta. F. Prunier. *R.G.E.* 28. *pp.* 635–646, *Oct.* 25, 1930.—Maxwell's equations are derived as the most general equations of motion of the ether. Properties of the ether are deduced, and the relation of these properties to electric, magnetic, luminous and gravitational phenomena discussed. The introduction of waves of the Schrödinger type leads to the conclusion that the theory of wave mechanics does not differ fundamentally from classical theory. [See also Abstract 2230 (1925).] J. S. G. T.

746. Calculation and Determination of Electromagnetic Fields in a Non-Euclidean Universe. Electromagnetic Expression for the Gravitational Forces acting upon Electrified Particles. M. Morand. *Ann. de Physique*, 14. *pp.* 191–261, *Oct.*, 1930.—The elements of absolute differential calculus and their application to electromagnetic and gravitational fields are briefly explained. An electric charge placed in a gravitational field is shown to experience an electric force (its weight) attributable to the action, upon the charge, of electric fields originating at all points of the gravitational field. " Weight " and " inertia " are then shown to be identical in amount, thus justifying the principle of equivalence of geometrical gravitational fields and permanent gravitational fields. Mass is a positional variable analogous to the gravitational potential $g_{44}/2$, and in general is represented by a tensor having 16 components. J. S. G. T.

747. World Function Relating to the Action Integral of Gravitation, Electricity and Matter. Part I. E. Reichenbächer. *Zeits. f. Physik*, 65. 7–8. *pp.* 564–570, 1930.—A form of the world function, with the consequential equations of the gravitational and electric fields, is derived from the wave equation [see Abstract 2831 (1927)]. J. S. G. T.

748. Generalisation of Einstein's Space-Type. V. Bargmann. *Zeits. f. Physik*, 65. 11–12. *pp.* 830–847, 1930.—A space-type, a so-called " direction-space " (*Richtungsraum*) in which direction-transfer but not length-transfer, is independent of the path, is discussed mathematically. J. S. G. T.

749. New Relativity Theory of the Unified Physical Field. W. Band. *Phys. Rev.* 36. *pp.* 1405–1412, *Oct.* 15, 1930.—This theory abandons the attempt to geometrise physics. Its aim is to give invariant differential equations of motion for mass-charge particles in regions where the indeterminacy of position and momentum is not significant. Eddington's displacement rule is used to define an indeterminate vector field, and a simple generalisation of it is used to define an indeterminate tensor field. The vector field gives the possible velocity of a mass-charge particle at any point, and vector lines in the field are necessarily the tracks of the particle. The tensor field defines an invariant element of arc by means of which the orbit equations are given in the familiar parametric form. Physical or actual fields are necessarily determinate functions and are defined by the variations of the indeterminate fields round closed loops in the usual way; but an alternative definition is suggested which does not depend upon such abstract processes. The usual identifications of the gravitation and electric field tensors give the classical laws for small fields. In the pure gravitation field the vector lines become Einstein's " geodesics," and for negligible gravitation field they become the empirical equations of motion of a charge in regions remote from atomic nuclei. The theory is purely a descriptive apparatus, and its usefulness is definitely limited by the principle of indeterminacy. This admitted limitation enables the theory to avoid the inconsistency between field and atomic theory, an inconsistency which appears as merely the result of ignoring the limitation. AUTHOR.

METEOROLOGY, GEOPHYSICS AND ASTROPHYSICS.

750. Gravitational Deviation of Solar Rays and the Thermal Region of High Tablelands. G. Tiercy. *Arch. des Sciences,* 12. *pp.* 297–318, *Sept.-Oct.,* 1930.—According to gravitational theory high tablelands ought to exert a feeble attraction on solar rays, thus giving a greater concentration and a higher annual mean temperature. The mean annual temperature of the Thibetan plateau when corrected to sea-level at the rate 1° C./200 m. gives a value of 25°–26° C., but the mean annual temperature in this latitude of 30°–35° N. is 21° C., the plateau thus being 4°–5° C. warmer relatively. The same relation holds in Asia Minor and over the high plateau of western N. America. From theoretical considerations, using the known deviation of solar rays, the net gain of heat day by day is calculated for thermal equilibrium to be attained. This leads to an excess temperature of 4°–6° C., while $1\cdot4 \times 10^9$ years would be required to reach this state. The duration depends on changes of shape of the Asiatic plateau in geological time, but it agrees approximately with calculation based on the radioactive content of the earth. A similar effect causes extra heating over land masses as compared with seas on account of the greater density of such masses. R. S. R.

751. Brightness Measurements of Twilight. F. Schembor. *Gerlands Beitr. z. Geophys.* 28. 1–3. *pp.* 279–292, 1930.—From measurements made of the brightness of diffused twilight on 7 days in the year 1928 by means of the potassium photoelectric cell without a colour screen, it is found that $\log J = a(1 + \sin^2 z) + b$, in which J is the measured intensity, z is the sun's zenith distance at the time of observation, and a and b are constants, the values of which are $a = +\ 122\cdot60 \pm 0\cdot07$ and $b = -\ 239\cdot90 \pm 0\cdot11$. Finally, a comparison is made between the results obtained with those given by Kähler, and Kalitin and Jaroslavtzev. R. C. F.

752. Eddy Motion in the Atmosphere. F. J. Scrase. *Meteorolog. Office, Geophys. Mem. No.* 52. [16 *pp.*], 1930.—Describes a method of studying the characteristics of eddy motion in the atmosphere. The eddy wind is defined as the difference between the instantaneous and the mean wind, and its three components (along the mean wind, perpendicular to it, and vertical) can be measured separately by methods described in the paper. The author finds that for " large-scale turbulence," where the eddy is averaged over an interval of one hour, the three components of eddy velocity are proportional to the wind velocity, at any rate at moderate and high wind velocities. For " intermediate scale turbulence," the mean values of eddy velocity over intervals of a few minutes are proportional to the mean wind velocity in the case of both the vertical component and that perpendicular to the mean wind direction. The " small-scale " eddies seem to have durations of the order of 1 sec. J. W. T. W.

753. Air Masses. H. Friedrichs. *Gerlands. Beitr. z. Geophys.* 28. 1–3. *pp.* 59–100, 1930.—Observations were made on cloudless days for two years at a maritime station, Wyk on Fohr, and a mountain station, Taunus Observatory. Ten different types of air masses, equatorial, polar or their derivatives were used according to Bergen phraseology and a comparison of the meteorological factors at the two stations in these respective air masses showed good parallelism in their average features. The factors considered were absolute humidity, temperature, equivalent temperature, visibility, blue colour of the sky and turbidity factors for radiation covering (1) the whole spectrum, (2) the red end and (3) the blue end of the spectrum. A connection was established between the turbidity factor and these meteorological elements. The absorption of the atmosphere, water vapour and dust depend on the wave-length and the air mass. With water vapour there is a maximum increase of turbidity in the red and least in the blue. Monthly and annual mean values show the variation of the meteorological elements in the various air masses. For all air masses temperature, absolute humidity, equivalent temperature, visibility and the blueness of the sky show a maximum in summer and the first two a minimum in January. R. S. R.

754. Atmospheric Pressure Effect of the Sunspot Period. Part I. Yearly Means. S. Hanzlik. *Gerlands Beitr. z. Geophys.* 28. 1–3. *pp.* 114–125, 1930.—The difference of mean air pressure for the three years of sunspot minimum and the succeeding three years of sunspot maximum for stations over the whole globe is set out in a chart for each of the last five sunspot periods, 1866–1919. Four different areas are indicated according to the sign of the effect. Areas of positive effect lie in the Indian monsoon region, pressure decreasing with increase of sunspots and *vice versa*. The fluctuations of this positive effect show a long period and a shorter one equal to two sunspot periods (Hale's period). Over belts in middle latitudes and the Arctic regions Hale's period is shown but it is positive in middle latitudes when negative in the Arctic and *vice versa*. In S. America there is a longer period but in a sense opposite to that in the Indian monsoon region. R. S. R.

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755. Counts of Condensation-Nuclei. V. F. Hess. *Gerlands Beitr. z. Geophys.* 28. 1–3. *pp.* 129–150, 1930.—Some 2600 counts of nuclei were made at Lans (Tyrol, 900 m.) by means of an Aitken-Luedeling counter of improved pattern. The total number per c.c. averaged 3290 for the summer of 1929, 3810 for that of 1930, with 12,000 as maximum and 560 as minimum. The number decreased with altitude, averaging (1929) 1330 at 2000 m. and 690 at 2300 m. Rain, high wind and especially the Föhn caused marked decreases. Neither intensity of sunshine nor transparency of the atmosphere had any definite effect, and Wigand's formula did not hold. Wind direction was also without effect, but strong winds (4–6 on the Beaufort scale) caused a definite decrease. Nuclei were fewest with medium humidity, both relative and absolute, and with medium temperature. Cloudiness had no effect, except when actually raining. The highest numbers seemed to coincide with a high and stationary barometer, the lowest with a falling one. There was some indication of low numbers preceding by some twelve hours change in the weather, pointing to a possibility of local forecasting. The probable number of heavy ions in pure country air is about 1000/c.c. C. A. S.

756. Pressure Waves and Harmonic Analysis. O. v. Schubert. *Gerlands Beitr. z. Geophys.* 28. 1–3. *pp.* 293–336, 1930.—Harmonic analysis of meteorological curves often leads to improbable results which may be due to the application of this analysis. From general considerations it is concluded that periodicities in pressure curves are not symmetrical in form. The influence of asymmetry on the results of harmonic analysis is found to be considerable and systematic but it cannot be proved in actual analysis of pressure curves on account of other well-known sources of error in the curves. A method, based on Weickmann's theory of points of symmetry, is proposed to find the length and form of individual oscillations without using harmonic analysis. The results are given for a number of cases and harmonic analysis is applied to some periods of the pressure curve for 1924, the length and form of which have been found by the new method. The amplitudes and phases so computed are divided into real oscillations and mere results of calculation and these are opposed to those obtained by the usual mode of application of harmonic analysis. R. S. R.

757. Seasonal Foreshadowing. G. T. Walker. *Roy. Meteorolog. Soc., J.* 56. *pp.* 359–362; *Disc.*, 362–364, *Oct.*, 1930.—The paper contains results obtained by the author and E. W. Bliss in applying various relationships in different parts of the world to predict abnormal seasons. The application has been made for (1) summer monsoon rainfall in Australia which gave 24 successes of excess or deficit in 28 years, 2 failures and 2 years normal; (2) S. African rainfall; (3) winter temperature in S.W. Canada, and (4) winter temperature in N.W. Canada. It is considered unwise at present to issue a prediction except in years when the indications of excess or defect are so strongly marked as to give a chance of success of 4 : 1 or 5 : 1 and this occurs in only about half the years. R. S. R.

758. Instruments for Obtaining Dry and Wet Bulb Temperatures. A. C. Best. *Roy. Meteorolog. Soc., J.* 56. *pp.* 365–373, *Oct.*, 1930. —The primary object of the investigation was to provide some suitable means of measuring dry and wet bulb temperatures on board ship suitable for use by a comparatively unskilled observer. The depression of the wet bulb depends upon the rate of aspiration, which should be constant or have a fairly high value. The paper gives an account of some comparative tests made with five psychrometers, including a Casella type of Assmann, a small Casella sling psychrometer, an American sling type and the wet and dry bulb thermometers in a Stevenson screen, which were compared with a modified Assmann psychrometer, the aspiration of which was effected by a small electric motor. One advantage of the electrically-driven instrument is that the aspiration past the wet bulb is constant and is maintained at 5 m. per sec. as compared with 1·5 m. per sec. for the maximum rate in the case of the Casella type of Assmann. The two sling psychrometers compare well, on the average, with the electric instrument but are difficult to handle. Comparison tests between the electric instrument and drying tubes show that the former instrument overestimates the relative humidity but nothing like to the same extent as the other instruments such as the Casella type of Assmann. In the *Discussion*, **F. J. Whipple** and **E. Gold** suggested the advisability of testing a genuine Assmann instrument. W. C. S. P.

759. Radiation Equilibrium and Humidity Distribution in a Semi-Grey Atmosphere. C. L. Pekeris. *Gerlands Beitr. z. Geophys.* 28. 4. *pp.* 377–389, 1930.—It is shown that in the Emden-Schwarzschild scheme of parallel radiation and semi-grey absorption, the two assumptions as to the values of the transparency of the atmosphere to solar and terrestrial radiation respectively suffice to fix the atmospheric boundary temperatures at radiation equilibrium, irrespective of the absolute amount and distribution of water vapour. The vertical temperature distribution in such radiation equilibrium is re-calculated by assuming the water vapour pressure (f) to depend upon temperature according to the Hergesell formula: $f = f_0 e^{23\cdot 56t/(273+t)}$, $f_0 = 3\cdot 12$ mm. Hg. The reason for the isothermal state of the atmosphere arrived at by Hergesell is principally to be found in the erroneous assumption that the mass integral $\int_0^1 f dm$ has the same value in an atmosphere in radiation equilibrium as in the atmosphere at Lindenberg. As a matter of fact, the value of this integral is already fixed by Hergesell's assumptions regarding transparency and by the above relation between f and t. AUTHOR.

760. Earth's Crust. H. Borchert. *Gerlands Beitr. z. Geophys.* 28. 1–3. *pp.* 32–54, 1930.—The application of the data of modern physics and astrophysics to the early stages of the earth's formation indicates a much longer period of formation and cooling than is generally accepted. The formation of chemical compounds must have been absent, and the first process must have been the condensation of the elements. Moreover, the early crust formation by crystallisation must, owing to the presence of an oxygen-rich outer zone, have been different from that observed in present-day magmas. The process of crystallisation of the first crust is described in detail. W. A. R.

761. Change of Gravitation in the Interior of the Earth. B. Haurwitz. *Gerlands Beitr. z. Geophys.* 28. 1–3. *pp.* 126–128, 1930.—Gutenberg making certain assumptions found that the acceleration due to gravity (g) in the outer 300 km. is approximately equal to that at the surface if the density of this outer crust is two-thirds that of the whole earth. The author establishes a general relation for g at various depths in a sphere having a symmetrical density distribution around its centre and shows that Gutenberg's result is based on more general relations of a sphere in accordance with the laws of gravitation. R. S. R.

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762. International Formula for Normal Gravity. G. Cassinis. *Bull. géodésique, No.* 26. *pp.* 40–49, *April-May-June,* 1930.—As the maximum distance between a point on the international ellipsoid and the corresponding point on the more theoretically accurate spheroid is only 3 metres with a corresponding difference in gravity of 0·001 cm./sec.^{2}, and as all observations for 250 years have used the ellipsoid, it is recommended that it be adopted as the surface of reference. Neglecting any component of gravity due to irregularities of the geoid relative to the ellipsoid, the value of gravity at (ellipsoidal) latitude ϕ is deduced as $978\cdot 049\,(1 + 0\cdot 0052884 \sin^2 \phi - 0\cdot 0000059 \sin^2 2\phi)$, which differs from Silva's spheroidal formula only by the sign of the third term. [See Abstract 3364 (1930).] C. A. S.

763. Approximate Rule for Distance between Geoid and Spheroid Assuming Complete Isostatic Compensation of Topography. W. D. Lambert. *Bull. géodésique, No.* 26. *pp.* 91–97, *April-May-June,* 1930.—Irregularities of mass are dealt with by the device of the mean load level. To determine this the ocean surface is deemed replaced by the surface obtained by compressing the ocean at each point until its density is that of standard surface rock ($\sigma = 2\cdot 83$). The surface of the globe is then deemed replaced by a spheroidal equipotential surface such that the total volume of rock projecting above it is equal to the volume of void below. Such a surface lies about 1650 m. below sea-level [see two following Abstracts]. If H denote the thickness, reckoned from mean load level, of standard rock whose presence (or absence) will produce the irregularity of load at a given place, it is given by the equations $H = h + 1650$, and $H = 1650 - h'(\sigma - 1\cdot 03)/\sigma$, for point on land or sea respectively, where h is the height of the points on land above, and h' the depth of one on sea below mean load level, and $1\cdot 03$ the density of the ocean. If H_R is the elevation of the geoid above the spheroid, d the depth of compensation, ρ the mean density and a the radius of the earth, $H = 3\sigma d H/4\rho a$, approximately. The effect of local irregularities is discussed, and values of H_R determined for various conditions. C. A. S.

764. Form of Geoid on Hypothesis of Complete Isostatic Compensation. W. D. Lambert. *Bull. géodésique, No.* 26. *pp.* 98–106, *April–May–June,* 1930.—Two methods of calculating H_R [see preceding Abstract] are worked out according as compensation is taken as concentrated in a layer at depth $d/2$, or is assumed to be uniform down to depth d. Variant forms of the hypothesis of isostasy are discussed. C. A. S.

765. Reduction of Observed Values of Gravity to Sea-Level. W. D. Lambert *Bull. géodésique, No.* 26. *pp.* 107–181, *April–May–June,* 1930.—A critical discussion of the free air, Bouguer, and isostatic methods for reducing observed values of gravity to sea-level, with particular reference to the determination of the figure of the earth, and the prediction of subsurface structure. For the former purpose the isostatic method is favoured as generally most satisfactory, though the free air method with Helmert's modification of Rudzki's method of inversion is useful in view of the desirability of keeping as close as possible to the actual earth. For predicting subsurface structure the isostatic method alone is really satisfactory when there are no reduced stations near, though in the neighbourhood of such the free air method gives fair results. Formulæ for all three methods are worked out, as also for the displacement of the centre of gravity. From Prey's representation of the topography by a series of spherical harmonics there are deduced the mean load level [see two preceding Abstracts], the direction of displacement of the centre of gravity, and the angular displacement of the pole of figure. A Bibliography is appended. C. A. S.

766. Magnetic Prospecting. A. Belluigi. *Pont. Accad. Sci., N. Lincei, Atti,* 83. *pp.* 261–265, *June* 19, 1930.—The investigation of the geological structure of the district of Scandiano S. Ruffino by magnetic and electrical methods is described. W. A. R.

767. Resistivity Measurements of Oil-Bearing Beds. F. W. Lee and J. H. Swartz. *Bureau of Mines, Techn. Paper* 488. [12 *pp.*], 1930.—Resistivity measurements for depths up to 400 ft. were made with a Gish-Rooney apparatus at three stations in Allen County (Kentucky), an area which had been partially explored for oil by drilling, and which was known to contain oil at shallow depths in strata consisting mainly of limestone rendered to a varying degree porous by the presence of sand. The inferences deduced from the measurements, though admittedly preliminary and requiring much more work to establish their validity, still showed substantial agreement with previous and subsequent drillings. C. A. S.

768. New Equipment at the Royal Observatory, Edinburgh. R. A. Sampson. *Optical Soc., Trans.* 31. 4. *pp.* 219–223; *Disc.*, 224–225, 1929–1930.—The author deals with the reasons which determined the form of the telescope—a Cassegrain reflector of 36 inches aperture and 54 feet focal length, serving a spectrograph of one, two or three prisms—and indicates the problems to which it is intended to apply it. These are, generally, the intensity of stellar light for different parts of the spectrum. It is pointed out that even an empiric treatment of this question led Adams to a method that had doubled our knowledge of stellar distances. A theoretical treatment, comprising a discussion of the behaviour of the photographic plate, led to fixing the temperature sequence. A slit spectrograph is required in order to deal with the lines. The state of the lines, combined with that of the continuous spectrum, conveys all the information that reaches us of the star's constitution and atmosphere. Subsidiary but highly interesting questions are those of selective absorption of light by the atmosphere of the earth. Behind these are the theoretical and laboratory investigations of the relation between intensity of light and the density of silver deposit on the photographic plate. The whole presents an attractive field. [See also two following Abstracts.] AUTHOR.

769. Three-Prism Spectrograph for the Royal Observatory, Edinburgh. J. H. Dowell. *Optical Soc., Trans.* 31. 4. *pp.* 226–228, 1929–1930.—A general description of the spectrograph, its attachment to the telescope, mounting, etc.

770. 36-Inch Aperture Telescope for the Royal Observatory, Edinburgh. C. Young. *Optical Soc., Trans.* 31. 4. *pp.* 229–232, 1929–1930.—A general description of the telescope, the optical system, telescope mounting, etc.

771. Solar Corona. W. Anderson. *Zeits. f. Astrophysik*, 1. 5. *pp.* 336–338, 1930.—Rosenthal [see Abstract 3673 (1930)] considers that the continuous spectrum of the inner corona, and the absence from it of the Fraunhofer lines, is due partly to irregular scattering and partly to Doppler effect. Objections are raised to both these causes. There are many difficulties also in explaining the equilibrium of the corona, although doubtless gravitation and radiation pressure must both play their part. It is possible that the emission lines of the coronal spectrum may be partly explained by Gurney's hypothesis for the chromospheric spectrum, viz. collisons caused by falling Ca++ atoms. M. A. E.

772. Heights in the Chromosphere from Eclipse Spectra. S. A. Mitchell. *Am. Phil. Soc., Proc.* 69. 7. *pp.* 433–439, 1930.—A short survey of the results which have led to our present knowledge of the sun's chromosphere, with special consideration of the question of the heights to which each line ascends. Saha's theory of ionisation receives brief mention and is shown to be one of the most important theories in astrophysics. There appears to be abundant evidence that relativity effects exist in the sun, but systematic differences in the latest results still exist after correcting for the relativity shift. These differences make it necessary to assume that there is a circulation in the sun's atmosphere, the atoms at a distance of 2000 km. from the sun moving inwards with a velocity of 0·2 km./sec., whilst those at a distance of 250 km. are moving away from the sun at approximately the same velocity. [See also following Abstract.] R. C. F.

773. Heights in the Chromosphere. S. A. Mitchell. *Astrophys. J.* 72. *pp.* 146–186, *Oct.*, 1930.—In the interpretation of solar and stellar phenomena the heights above the photosphere are of the utmost importance, a line of Rowland intensity 10 taking its origin to a greater effective height than one of intensity 4. The flash spectrum, as briefly indicated in a previous publication [see preceding Abstract], is the only direct method of obtaining heights in the chromosphere, and neutral iron only is considered in the present paper owing to the large number of lines involved. Although the strongest lines reach the greatest heights, yet they are of the lowest excitation potential. The Evershed effect found in sunspots is also found in flash spectrum data, and by dividing the spectrum at 4900 Å. both heights and excitation potentials show similar equalities for intensities two units greater in the red than in the violet. This indicates that the underlying cause of the peculiarities observed is to be found in the number of contributing atoms. When the data are divided at 4900 Å. the products of heights and excitation potentials are found to be constant. The unit nature of the multiplets is illustrated by $a^5\mathrm{F} - y^5\mathrm{D}^0$, showing close correlations between intensities, heights obtained from flash spectrum, Evershed effect, and differences in sun minus vacuum arc wave-lengths. A simple explanation of the differences in "effective heights" of strong and weak lines can be given from a consideration of the differences in the number of atoms involved and the differences in concentration between multiplets of low- and high-excitation potentials. Unsöld's theory is discussed, and finally a circulation theory of iron vapour in the chromosphere is suggested, the atoms ascending through the medium of many weak lines of high-excitation potential, and descending through the medium of fewer lines of great strength but of low-excitation potential. R. C. F.

774. Origin of the Variations in the Sun's Rotational Velocity. R. Gunn. *Phys. Rev.* 36. *pp.* 1251–1256, *Oct.* 1, 1930.—The observed variations of the sun's rotation with solar activity are shown to be accounted for by changes of the electric and magnetic fields in the solar atmosphere. It is assumed that the sun's electric field arises from an electron or negative ion current flowing away from the sun's surface. The ionised atmosphere offers electrical resistance to the current and calculations show that the heat generated in the solar atmosphere is an appreciable fraction of the total radiated light energy. The electric field is thus correlated with the solar constant and since the solar constant is known to vary with the sunspot cycle, the atmospheric electric field, and hence the rotational period, must go through similar variations in magnitude. The sub-atomic processes which might give rise to the solar current are mentioned. AUTHOR.

775. Orbit of the Trans-Neptunian Planet. E. Esclangon. *Comptes Rendus*, 191. *pp.* 629–631, *Oct.* 20, 1930.—Photographic observations of the planet since August at Paris, Yerkes and Heidelberg have been combined with the Paris observations for January to May to calculate the orbit anew. These show that the planet during one revolution varies its distance from the sun between 30 and 50 astronomical units, exceeding that of Neptune except perhaps at perihelion. The longitude of the node and the inclination, the former especially, are determined with great exactitude; others, notably the eccentricity and the longitude of perihelion, must be modified slowly by observations of years to come. R. S. R.

776. Mercury's Polarisation Compared with Moon's. Results at Pic-du-Midi in 1930. B. Lyot. *Comptes Rendus*, 191. *pp*. 703–705, *Oct*. 27, 1930.—A continuation of the author's work [see Abstract 554 (1930)], being 26 observations made between July 9 and August 10, 1930, the phase angle varying between 4° 49′ and 62° 29′. A diagram is given. Near inferior conjunction Mercury's curve is sensibly parallel to that of the moon, but is feebler. The negative branch limits an area greater than that found on any other planet or any other subject studied. Up to the present, volcanic ash alone presents a maximum negative polarisation as great, with an angle of inversion as steep. Mercury's surface must, like the moon's, be covered with a powder resembling ash. The increasing phases of Mercury are distinguished by four small features, these corresponding to different parts of the planet as shown by the observations of Schiaparelli and Antoniadi. Mercury's surface is therefore more homogeneous than the moon's. A. S. D. M.

777. Movements of Large Meteors. V. G. Sladbey. *Comptes Rendus*, 191. *pp*. 699–701, *Oct*. 27, 1930.—The material used is Hoffmeister's catalogue of the elements of 611 large meteors, and for these in general the author finds that the mean height of appearance is 131·9 km. (545 cases), and of extinction as 53·5 km. (553 cases). Dividing the latter into classes, he finds for great meteors a height of extinction of 59 km. (445 cases); for detonating meteors, 32 km. (100 cases); and for meteorites, 23 km. (8 cases); for these three subdivisions respectively, the mean geocentric velocities in km./sec. are 42·5 (400 cases), 38·8 (87 cases) and 25·7 (5 cases), indicating a variation in the mean heights of extinction in the same sense as in the mean geocentric velocities, thus confirming Niessl's previous work. But the author finds that Niessl's relationship between the heights of extinction and the elongation of the radiant points from the apex of the earth's motion is not established. For the lengths of the mean trajectory he gets for great meteors 231 km. (537 cases), and for detonating meteors 250 km. (106 cases); for heliocentric mean velocity he gets from 483 cases, 52·8 km./sec. (hyperbolic velocity). A. S. D. M.

778. Globular Cluster M92 in Hercules. J. Hopmann. *Pont. Accad. Sci., N. Lincei, Atti*, 14. *pp*. 167–202, 1930.—Four photographs of this cluster were taken at Bonn Observatory in 1916, 1917, and 1918, and this paper describes how they were measured and gives a catalogue of 1244 stars, with positions and magnitudes. The cluster is strongly condensed at the centre, and here, as well as in other regions near it, there is a grey background of innumerable faint stars, with a curious system of lanes in its structure, and with brighter stars superposed upon it. Outside the centre are some double stars and groups of bright stars too close together to be measured separately. M. A. E.

779. Explanation of Some Anomalies Presented by Stellar Proper Motions. H. Mineur. *Comptes Rendus*, 191. *pp*. 701–703, *Oct*. 27, 1930.—For the longitude of the centre of galactic rotation, stellar proper motions have given values near 350° which are systematically too great, and similarly they give Oort's coefficient A, greater than that deduced from radial motions, the explanation being in the existence of a second asymmetrical drift [see Abstract 3087 (1930)]. The author calculates the mean proper motion of stars of coordinates α, δ, and assuming this movement is due to Oort's differential rotation and to the second asymmetrical drift, he obtains the formulæ: $\mu_\alpha \cos \delta = A_1 \cos 2\alpha + B_1 \sin 2\alpha + C_1 \sin \alpha + D_1 \cos \alpha + E_1$, and $\mu\delta' = A_2 \cos 2\alpha + B_2 \sin 2\alpha + C_2 \sin \alpha + D_2 \cos \alpha + E_2$. He applies these to the uncorrected proper motions of 6000 stars in Boss's Preliminary Catalogue and finds that the value of l_0 seems to be in satisfactory accordance with that derived from radial velocities. A. S. D. M.

780. Red Magnitudes of Bright Stars. E. S. King and Ruth L. Ingalls. *Harvard Coll. Obs., Ann.* 85. 11. *pp.* 191–202, 1930.—Red magnitudes of 37 stars are obtained by extra-focal methods [see Abstract 792 (1924)]. The scale of these is made to coincide with the photovisual scale for A stars, the red magnitudes found with the 8-inch and the 11-inch telescopes agreeing with the photovisual scale by adding 0·04 mag. and 0·03 mag. respectively, and showing that the two investigations are in substantial agreement. Thus photometric, photographic, photovisual and red magnitudes are brought into concordance. Grouping the 37 colour indexes according to spectrum class, the following means are obtained: B0, − 0·16; B2, − 0·06; B8, + 0·02; A0, 0·00; A2, + 0·02; A3, − 0·04; F5, − 0·20; F8, − 0·23; G0, − 0·32; G5, − 0·31; K0, − 0·46; K2, − 0·66; K5, − 0·64; M, − 0·95; and plotted, colour index against spectral class, and a smooth curve drawn through them. The colour excess thus given indicates that faint blue B, A and F stars are brighter; faint G, K and M stars are fainter than the normal when photographed in red light. A. S. D. M.

781. Variable Lines of Hydrogen in the Spectrum of 52 π Aquarii. C. D. Higgs. *Astrophys. J.* 72. *pp.* 187–190, *Oct.*, 1930.—Reproductions of spectra of π Aquarii are shown, exhibiting the variability of spectrum characteristic of B_e stars. Measurements of radial velocities of components of bright H lines are shown. Attempts to correlate the separations of these, or their velocity shifts, with the variations in intensity, or to establish a period for the latter proved futile. The scattering would seem to be due mainly to photographic effects. Contours of some of these lines are reproduced, and the bibliographical and observational record of π Aquarii is included. AUTHOR.

782. Absorption Lines of Sulphur (SIII and SII) in Stellar Spectra. F. E. Roach. *Astrophys. J.* 72. *pp.* 191–198, *Oct.*, 1930.—Several stellar lines are identified as due to the ion of SIII. Six lines not previously measured are attributed to the ion of SII, and a number of lines already measured are corroborated. Computations have been made involving the principles of thermal ionisation as affecting the intensity of absorption lines. The observed position of maximum intensity of the sulphur lines is found to agree satisfactorily with the predictions of theory, namely, in spectral classes B5 and B1 for SII and SIII, respectively. AUTHOR.

783. Coexistence of Stellar and Interstellar Calcium Lines in the Eclipsing Binary U Ophiuchi. O. Struve. *Astrophys. J.* 72. *pp.* 199–201, *Oct.*, 1930.—The eclipsing variable U Ophiuchi of spectral type B8 (Harvard) was photographed with the single-prism spectrograph attached to the 60-inch reflector of the Mount Wilson Observatory. Three plates taken near maximum separation of the lines show a fairly strong narrow absorption line due to interstellar calcium, between two faint and diffuse stellar components. The spectrum also reveals the presence of interstellar sodium lines. This is regarded as a further proof in favour of Eddington's theory of interstellar matter. AUTHOR.

784. Total Absorption as Measure of Number of Dispersion Electrons. W. Schütz. *Zeits. f. Astrophysik.* 1. 5. *pp.* 300–313, 1930.—By two methods can the number of dispersion electrons responsible for an absorption band be determined in the classical electron theory; in both the spectrum intensity is found as a function of the frequency (ω) of the wave-length (λ). In method A the contour is found either from calculation or observation to be independent of the resolving power of the spectral apparatus, and the author describes the research of Fuchtbauer and his school. In method B, the absorption band contour is conditioned by the deficient resolving power of the apparatus. This method B was investigated independently by Minkowski [see Abstract 2386 (1926)] and by the author [see Abstracts 682 (1927) and 112 (1928)]. In the second part of the paper the order of experiment is given, the absorption lines employed being 4555 and 5498 of cæsium, and diagrams illustrate the total absorption of these as functions of vapour density and of their ratio of total absorption. A. S. D. M.

785. Interstellar Calcium. A. Unsöld, O. Struve and C. T. Elvey. *Zeits. f. Astrophysik,* 1. 5. *pp.* 314–326, 1930.—The authors treat the relation between total absorption (E) and number ($\mathfrak{N}$) of atoms in a column of 1 cm.^{2} sq. section. Two limiting cases exist, (*a*) line contour is determined by radioactive-damping ($E = 5 \cdot 70 \,.\, 10^{-9}\sqrt{\mathfrak{N}}$ [see Abstract 3304 (1929)], (*b*) it is fully produced through the Doppler effect ($E = 1 \cdot 3_7 \,.\, 10^{-13}\, \mathfrak{N}$) [see Abstracts 2136 and 2696 (1929) and preceding Abstract]. The stars, α Cam, 19 Cephei and 68 Cygni, were examined as having strong interstellar lines; the measured intensities were taken as functions of λ and the total intensity was directly taken by a planimeter; in all three H (calcium) is cut down more or less by the violet wing of H_ϵ (hydrogen); the intensity of H is measured from the wing (not as of K from the continuous spectrum) and the values of K/H are given. Their contours show a combination of Doppler effect and radiative damping. The absolute magnitudes derived seem to indicate for α Cam and 19 Cephei a local condensation of interstellar material. Thermic Doppler effects play no part in interstellar space. Weak interstellar lines depend more on radiative damping, strong lines on Doppler effect. The ratio of Doppler effect to radiative damping moreover depends on galactic longitude. The density distribution of interstellar calcium is considered; lower and upper values of limiting number of atoms for Doppler widening only ($N = 1 \cdot 0_5 \,.\, 10^{11} \,.\, D^{0 \cdot 41}$) and for radiative damping only ($N = 4 \cdot 2_5 \,.\, 10^{12} \,.\, D^{0 \cdot 82}$) are found; and it is concluded that the value of density distribution decreases with distances in the neighbourhood of the sun as ($D^{-0 \cdot 18}$)—disagreeing with the conclusion of Plaskett and Pearce—and for greater distances as $D^{-0 \cdot 59}$. These results are uncertain but, on other considerations, not improbable. A. S. D. M.

786. Velocities of Calcium and Hydrogen Lines in Prominences. E. J. Perepelkin. *Zeits. f. Astrophysik,* 1. 5. *pp.* 326–330, 1930.—With the 3-prism spectrograph and the 30-inch refraction of Pulkovo, 448 radial velocities were taken in 1928 and 1929. The results are: (1) the dispersion of Ca+ velocities is greater than the dispersion of hydrogen, and similarly the Ca+ velocities are much greater. (2) There is a strong correlation between Ca+ and hydrogen velocities; the regression curves are straight lines. The conclusions are that: (1) prominences cannot be hydrodynamic appearances nor simple gas streams; (2) the theory of radiation pressure can explain the results sufficiently. A. S. D. M.

787. Interstellar Absorption Within the Milky Way. K. F. Bottlinger and H. Schneller. *Zeits. f. Astrophysik*, 1. 5. *pp.* 339–342, 1930.—The Trümpler hypothesis of a band of light-absorbing material in the plane of the Milky Way is investigated by an analysis of the distances of 171 δ-Cepheids from this plane. The authors calculate that if cepheids of all distances from the sun are, on the average, equidistant from the plane of the Milky Way, an absorption of 2 magnitudes per 1000 parsec must be taking place. Such an absorption can also be arrived at if the reduction with distance of the density of matter in space, obtained by counting the number of stars, is interpreted as due to an absorbing layer. The conclusion is that the absorbing layer of Trümpler exists and is probably thicker than he supposed. G. C. McV.

788. Interlocking of Lines in Absorption Spectra. R. v. d. R. Woolley. *Roy. Astron. Soc., M.N.*, 90. *pp.* 779–787, *Oct.*, 1930. *Supplement.*—A previous paper by this writer contained a discussion [see Abstract 1782 (1930)] of H. A. Wilson's formula for the coefficient of line absorption in the formation of solar and stellar absorption lines. But since the formation of any absorption line in an atmosphere is a consequence of departure from thermodynamical equilibrium, we cannot consider it without conducting a simultaneous discussion of the formation of all the lines with which it is interlocked. This discussion leads to the conclusion that, making the same approximations as are ordinarily made in the case of a principal line, the contour found for a line such as Hα has the same width as if no interlocking had taken place. Therefore we can determine numbers of atoms in the ordinary way from Hα alone, and ignore the phenomenon of interlocking. A physical cause for this is suggested. M. A. E.

789. Cyanogen Band Near λ4200 in Spectra of Three Cepheid Variables. A. V. Douglas. *Roy. Astron. Soc., M.N.* 90. *pp.* 798–805, *Oct.*, 1930. *Supplement.*—Cyanogen has two well-known bands at λ4216 and λ4197, and in stellar spectra an absorption band extending widely on either side of λ4200 has been recorded by various writers in recent years. Elvey attributes it to selective absorption in the glass of the optical system, but tests made by the writer prove that on Dominion Observatory spectrograms it is certainly not due to instrumental effect; nor can it be due to overlapping of the wings of closely adjacent lines: it may therefore be accepted as due to stellar cyanogen. In three Cepheid variables this band varies in intensity with phase, but, contrary to expectation, its intensity curve resembles that of the hydrogen and enhanced lines and is opposed to that of the Fraunhofer G band, which is believed to be due to the hydrocarbon molecule CH. The only explanation for this abnormal behaviour of CN that suggests itself at present is that the band may have its origin at a very high level in the stellar atmosphere, like the enhanced lines of iron, etc., and therefore it will absorb radiation in accordance with the temperature existing at that level at any given instant, but with a time lag relative to the deeper levels, since increase in the interior of a pulsating Cepheid may precede increase in the exterior by a period of time measurable in days. The high level of the CN molecule is probably to be explained in the same way as the high level of ionised calcium atoms in the sun's chromosphere. M. A. E.

790. Temperature Scale of Stars. H. Kienle. *Zeits. f. Astrophysik*, 1. 5. *pp.* 332–335, 1930.—The stellar temperatures determined by different investigators differ considerably, and in a recent communication (L.O.B. 401) Storer derives a scale of 4400° to 25,000°, which is higher by 20 % than that adopted by Russell. He states that it is very improbable this scale can be affected by any systematic error, but his methods, especially in estimating and interpreting line intensities, are such as to raise grave doubts in this respect. The main purpose of his work, however, is to determine qualitative differences in continuous spectrum between giants and dwarfs, and this is fortunately not affected. M. A. E.

791. Effect of Stellar Boundary Conditions. A. S. Eddington. *Roy. Astron. Soc., M.N.* 90. *pp.* 808–809, *Oct.*, 1930. *Supplement.*—The author replies to criticisms by Milne [see Abstract 3690 (1930)] of his recent paper on the effect of boundary conditions on the equilibrium of a star [see Abstract 2120 (1930)]. It is suggested that the discrepancies between the results obtained by Milne and Eddington are due to the fact that the former postulates that a star has a small central nucleus of "white dwarf" density surrounded by a tenuous envelope, whereas the latter postulates that a star is perfectly gaseous. G. C. McV.

792. Ratio of Sector to Triangle in Orbit-Determination. R. T. A. Innes. *Roy. Astron. Soc., M.N.* 90. *pp.* 810–816, *Oct.*, 1930. *Supplement.*—It is shown that Bazhenov's formulæ for deriving the ratio of the sector to the triangle are unsuitable for computation. The formulæ are modified accordingly and a new table for deriving η from h is given. G. C. McV.

793. Orbit of H.D. 32990 (103 Tauri, Boss 1216). S. N. Hill. *Dominion Astrophys. Obs., Victoria, Publ.* 4. 16. *pp.* 261–269, 1929.—Ninety-five spectra of H.D. 32990 are the basis of the determination of the spectroscopic orbit. Fifty-nine of these observations were taken at the Mt. Wilson Observatory and combined with the thirty-six Victoria observations, resulting in a period of 58·31 days, eccentricity 0·189 ± 0·017 semi-amplitude 36·73 ± 0·66 km. and γ + 16·22 ± 0·48 km. The probable error of a plate is ± 4·46 km. per second. AUTHOR.

794. Orbit of Boss 3180. W. E. Harper. *Dominion Astrophys. Obs., Victoria, Publ.* 4. 18. *pp.* 303–307, 1930.—Twenty-nine spectrograms of this K0 star were used in 1928 to derive the elements of the orbit of this spectroscopic binary. There appeared to be irregularities in the radial velocity curve which warranted additional observations. Thirteen more plates made in 1929 and 1930 are incorporated with the earlier observations to derive new elements which do not differ materially from the old. No period can be found for the supposed irregularities, hence the probable error of a plate ± 2·0 km. per sec., is higher than usually found for a K type star. The period is 461 days and eccentricity 0·169. AUTHOR.

795. Luminosity Distribution in Interior of Elliptical Nebulæ. P. ten Bruggencate. *Zeits. f. Astrophysik*, 1. 5. *pp*. 275–299, 1930, *and* 2. 1. *pp*. 83–84, 1931.—The author gives the integral equation by which the luminosity distribution in space of a nebula rotating symmetrically is connected with the intensity distribution as projected on the sky; and he investigates the particular case of the isophotal layers in the nebula's interior for concentric, coaxial and similar rotation-ellipsoids; these are in good agreement with Hubble's observations [see Abstracts 1683 (1927) and 3691 (1930)]. The most important part of Hubble's work follows from the equation $\log I = K - 2 \log (r + a)$, where r is the distance from the nebula's centre, k is a constant which changes from nebula to nebula, and a another constant changing from nebula to nebula and from axis to axis; he gives this equation in a different form and finds that, if the limits of luminosity and of density centre are determined, it indicates that all nebulæ must have nearly the same ratio of axes (3 : 10). It follows that if the luminosity distribution inside elliptical nebulæ is proportional to the density expressed in terms of central density, then all nebulæ are identical in density distribution. This is confirmed, qualitatively, by computation of the probability of different ellipticities in elliptical nebulæ. To a final approximation, nebular brightness is inversely proportional to the square of distance from the centre. Elliptical nebulæ seem to consist of a more or less strongly condensed luminous core whose light is scattered or reflected equally in all directions by surrounding matter. A. S. D. M.

796. Solar Apex and Galactic Rotation. H. Mineur. *Roy. Astron. Soc., M.N.* 90. *pp*. 789–797, *Oct.*, 1930. *Supplement*.—The author finds that the apex varies systematically with the distance (z) of a star from a plane parallel to the galactic plane and passing through the sun; that the variation of the declination of the apex from + 20° to + 70° (according to the stars considered) is real, and in consequence it may be necessary to revise the absolute magnitudes of the Cepheids. He gives a diagram of the projection on the galactic plane of the solar motion velocity vector curves with respect to groups of stars for different values of z and finds a second asymmetrical drift, not unlike Strömberg's, but at longitude about 320°, and this can be accounted for by a differential rotation. He describes the method of specifying the longitude of the centre of rotation, his results giving confirmation that the nearest stars have their centre of rotation at longitude 240° and the distant at 330°. He discusses Kapteyn's drift as an alternative to the local cluster and enumerates the objections to the rotation of the local cloud and suggests that this latter is a kind of vortex in the galaxy. He finds that the sun's motion does not appear to depend on spectral class. A. S. D. M.

LIGHT.

797. Filters for the Infra-Red. H. G. Hirsekorn. *Ann. d. Physik*, 6. 8. *pp*. 985–1000, *Oct*. 10, 1930.—The transmission of thin films of NaCl, KCl, NH_4Cl, and TlCl, deposited by evaporation, is measured from 40 to 140 μ, using a wire grating. It is found that the absorption breadth increases in the order Na, NH_4, K, Tl, and that the curves are distinctly unsymmetrical, and pass through 2 or 3 minima in this region.

J. H. A.

798. Metallic Reflection. J. Zahradníček. *Zeits. f. Physik*, 65. 11–12. *pp*. 814–823, 1930.—Formulæ relating to metallic reflection, due to Drude, Macků and the author are compared by utilising experimental results relating to reflection by silver and lead sulphide and data relating to thirteen metals determined by Drude. J. S. G. T.

799. Refractive Indices of Mixed Crystals of Magnesium Sulphate and Zinc Sulphate. Mary W. Porter. *Zeits. f. Krist.* 75, 3–4. *pp*. 288–300, *Oct*., 1930. *In English*.—In (orthorhombic) mixtures of magnesium sulphate and zinc sulphate the principal refractive indices are found to be directly proportional to the composition, either as expressed in volume or molecular percentage, or in percentage by weight, and their variations can be represented by three straight lines. This is in agreement with the variation of the principal refractive index along the symmetry-axis *b* observed in monoclinic mixtures. [See Abstract 2466 (1925).]

C. B. A.

800. Modified Brögger-Ramsay Method for the Measurement of Refractive Indices of Crystals. W. Faber. *Zeits. f. Krist.* 75. 3–4. *pp*. 332–336, *Oct*., 1930. *In German*.—A method for determining the three chief indices of refraction of bi-axial crystals (using natural prisms), in which a modification of the Brögger-Ramsay arrangement is used. A plane-parallel trough is set up with its walls perpendicular to the incident radiation, and the prism is embedded in a medium of refractive index n_ϵ. The refracting angle is measured (ϕ), and the deviation α. The required index of refraction n_x corresponding to the value of α is given by the formula

$$n_x = \sqrt{n_\epsilon^2 - \sin^2 \alpha} \cot \phi \sin \alpha.$$

As an example of the accuracy obtained, a comparison is given for aragonite as follows (referred to the D line):

	By Minimum Deviation.	Author's Method.
n_α	= 1·5305(5)	1·5305(9)
n_β	= 1·6811(9)	1·6812(2)
n_γ	= 1·6861(9)	1·6863(7)

F. I. G. R.

801. Total Reflection Method for a Crystal Face of any Orientation. F. Schwietring. *Zeits. f. Krist.* 75. 5–6. *pp*. 449–501, *Oct*., 1930.—A summary is given of previous publications on the total reflection method for determining refractive indices. The polarisation of the limiting rays is considered theoretically and a method of measurement is given which takes into account quantitatively the degree of polarisation, the intensity of the portion of natural light polarised by reflection being represented as a function of the angle of incidence. The method is applied to a number of minerals. T. H. P.

802. Measurements on Rock-Salt in the Infra-Red for Testing the Dispersion Theory. M. Czerny. *Zeits. f. Physik*, 65. 9–10. *pp.* 600–631, 1930.—The author reviews the previous measurements, in the infra-red, of the reflection factor and absorption coefficient of rock-salt and reports further measurements. A grating spectrometer was used as a monochromator, the incident radiation having previously been resolved partially by the residual ray method. For the absorption measurements very thin plates of rock-salt were required and a method for preparing lamellæ down to 8 μ thickness is described. The measurements show a second smaller maximum in the reflecting power at 39 μ, in addition to the known maximum at 52 μ. Sylvine (KCl) was also found to give two maxima at 62 μ and 46 μ respectively. It is shown that the data are fairly well represented by dispersion formulæ, except that on the short-wave side of the resonance wave-length marked systematic deviations occur for the extinction coefficient. W. S. S.

803. Spherical Projection Chart for Use in the Study of Elliptically Polarised Light. F. E. Wright. *J.O.S.A.* 20. *pp.* 529–564, *Oct.*, 1930.—The constants of an elliptical vibration are determined by transformation either to a rectilinear vibration or to one of small known ellipticity and then measuring the azimuth of the transformed vibration. From these measurements the constants of the elliptical vibration can be computed or ascertained by graphical methods. For the transformation crystal plates of known thickness and birefringence are used. Using Poincaré's method, a specially prepared angle or stereographic projection chart is used as a base to facilitate graphical solutions, and a description of the chart and its methods of use in deriving the equations and the solution of elliptical problems is given. R. S. R.

804. Electro-Optical Modification of Light Waves. L. H. Stauffer. *Phys. Rev.* 36. *pp.* 1352–1361, *Oct.* 15, 1930.—Broadening of the satellites of the Hg green line λ5461 was observed when the light passed between the plates of a Kerr cell on which was impressed a varying e.m.f. having a frequency of 2×10^7 sec^{-1}. The e.m.f. was obtained by superposing the output of a vacuum tube oscillator upon a steady potential of about 7000 volts. The maximum oscillator voltage was about 5000 volts. With this voltage the fine structure of the Hg green line became so diffuse that two satellites having a separation of 0·045 Å. were scarcely resolved by the Lummer-plate. The broadening was observed to increase rapidly with the oscillator voltage. The observed effect is predicted by the classical electromagnetic theory and the quantum theories of dispersion of Kramers-Heisenburg, Schrödinger, and Dirac. The h.f. voltage effects a rapid variation of the refractive index of the nitrobenzene in the Kerr cell which in turn produces a corresponding variation in optical path, giving the source a virtual velocity, and thereby producing a Doppler effect. The magnitude of the observed broadening is in agreement with the predictions of theory. AUTHOR.

805. Optical Activity and Salt Effect. P. A. Levene and A. Rothen. *J. Phys. Chem.* 34. *pp.* 2567–2581, *Oct.*, 1930.—The following measurements are made: the rotation of undissociated mandelic acid and the mandelate ion, the temperature coefficients of these rotations, the effect of strong bases and of neutral salts on the rotation of the ion, and the effect of neutral salts on the rotation of *a*-methylglucoside and sucrose. The salt effect can best be explained on the assumption that the anion and kation have opposite effects on the deformation of the optically-active electrolyte and therefore on the optical rotation. The effect of non-ionisable polar molecules is similar to that of electrolytes. The kation produces an increase in the rotation of mandelic acid, as does also the addition of one H^+ to the ion. The effect of concentration on the rotation is found to be opposite in direction to that of the temperature, which would be expected if it is due to the mutual effect of the active molecules. The numerical value of the change in rotation produced by monovalent metals is small compared with that produced by ionisation, but the effect of divalent metals is considerable. This must be taken into account in the determination of degree of dissociation by the optical method. The results from this are in agreement with the theory of complete dissociation of the salts of weak electrolytes. The effect of electrolytes on the rotations of *a*-methylglucoside and of sucrose is less marked than for mandelic acid, particularly with divalent ions. C. B. A.

806. Natural Optical Activity of Liquids. H. Volkmann. *Zeits. f. phys. Chem.* 10. *Abt. B.* 3. *pp.* 161–188, *Oct.*, 1930.—The dependence of rotatory power on refractive index expected from the Born-Gans theory of natural optical activity is confirmed by measurements of the rotations of solutions of *d*-limonene, the molecule of which is shown by measurements of dipole moment and ultra-violet absorption to be only slightly deformed by the solvent. Deviations from the theory found with substances with large moments, such as menthone and camphor, are attributed to intermolecular forces. These are studied in the case of menthone, the effects of concentration and of homologous series of solvents being investigated. The magnitude and direction of the effects correspond closely to those observed in the absorption spectra. Agreements with theory obtained when solvent and active substances are similar are attributed to the effect of similar fields, and an analogy is drawn with the Meerwein experiments on the activation of acetone by addition of water. The question of the high solvent powers of acids in consequence of the strong electric fields of the ions is also discussed. C. B. A.

807. Magneto-Optic Method of Chemical Analysis. F. Allison and E. J. Murphy. *Am. Chem. Soc., J.* 52. *pp.* 3796–3806, *Oct.*, 1930.—An application of investigations of the time-lag of the Faraday effect behind the magnetic field as a function of the wave-length of the light used [see Abstract 2697 (1927)]. Each compound studied produces, irrespective of the presence of other compounds, a characteristic minimum (or minima) of light, which does not disappear until the concentration is reduced to about one part in 10^{11} of water. The differential time-lag is found to be some inverse function of the chemical equivalent; and with few exceptions, the number of characteristic minima is equal to the number of known isotopes of the metallic element in the compound. C. B. A.

808. Scattering of Light in Aqueous Sodium Silicate Solutions. L. L. Burgess and K. Krishnamurti. *Faraday Soc., Trans.* 26. *pp.* 574–577, *Oct.*, 1930.—The scattering of light in commercial sodium silicate

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solutions, diluted to 2 M. with respect to SiO_2, and filtered through hardened filter paper to remove suspended particles, is measured. Below the molar ratio $SiO_2 : Na_2O = 2\cdot 5 : 1$ the Tyndall intensity is small and practically constant; but above this ratio the light scattering capacity increases slowly at first but more and more rapidly as the silica content in the solution increases. These results indicate the formation of colloidal complexes above the ratio $SiO_2 : Na_2O = 3 : 1$. It is probable that these particles become much coarser with further increase in the ratio. A. J. M.

809. Scattering of Light through Small Angles. G. I. Pokrowski. *Zeits. f. Physik*, 65. 1–2. *pp.* 130–132, 1930.—The dependence of the intensity of light-scattering on the angle of scattering is investigated for glass, water and alcohol-water. For small angles the intensity is inversely proportional to the angle. This fits in with earlier theoretical considerations. [See Abstract 2496 (1930).] A. C. M.

810. Interference Colours Obtained by Combination and Mixture of Doubly-Refracting and Optically Active Crystals. A. Ehringhaus. *Zeits. f. Krist.* 75. 3–4. *pp.* 179–195, *Oct.*, 1930.—If N_1, N_2 and N are the relative dispersions of the double refraction (*i.e.*, $N = \Delta D/(\Delta F - \Delta C)$, etc., where ΔC, etc., are the birefringencies for the C, etc., lines) of plates of two different crystals, and N that of their combination d_1, d_2 the thicknesses of the plates, then (for *e.g.* the D line)

$$N = N_1N_2(d_1\Delta D_1 \pm d_2\Delta D_2)/(N_2d_1\Delta D_1 \pm N_1d_2\Delta D_2)$$

By varying d_1, d_2 combination plates or wedges possessing almost any desired value of N, and also of retardation (*e.g.*, a Laurent's analyser with variation of only 1 % within the visible spectrum) can be prepared from almost any desired material, thus enabling only such to be used as possess suitable physical properties. Similar formulæ are worked out for mixed crystals, *e.g.*, of strontium and lead dithionates, and also for the relative dispersion of the rotatory power, $R=\rho_D\lambda_D/(\rho_F\lambda_F-\rho_C\lambda_C)$, where ρ_D, etc., are the rotatory powers for the D, etc., lines, giving combinations suitable, *e.g.*, for use in a saccharimeter. Many examples are worked out. C. A. S.

811. Phase Anomaly for a Spherical Wave. J. Picht. *Zeits. f. Physik*, 65. 1–2. *pp.* 14–17, 1930.—It is shown that for the axial points of a spherical wave delimited by a circular aperture, the phase anomaly, instead of equalling π as stated in standard works, fluctuates between 0 and 2π. W. S. S.

812. Resolving Power. R. W. Ditchburn. *Roy. Irish Acad., Proc.* 39. *pp.* 58–72, *Oct.*, 1930.—The Rayleigh criterion for resolving power is examined and its usefulness and limitations discussed, the practical differences between visual resolution and resolution by photographic photometry being considered. A separation of resolution into three stages is suggested. The resolution of lines of unequal intensity and of finite breadth is considered, and a rough experiment on the resolution of emission and absorption lines is described. These considerations are applied to the design of instruments of high resolving power. C. B. A.

813. Surroundings of a Ray in the Optical System. M. Herzberger. *Zeits. f. angew. Math. u. Mechanik.* 10. *pp.* 467–486, *Sept.–Oct.*, 1930.—The author gives a mathematical development of geometrical optics in which the latter is considered as a part of linear geometry. Gullstrand's work on different systems in optics for the diagram surrounding a ray is considered. The central ray is treated as the axis of a rotating system and this leads on to the laws of Gauss. In continuation of Abbé's considerations the diagrammatic laws valid for the first order in general systems are shown as linear ray diagrams and completely developed. The Gullstrand results which ensue are arranged in the general theory. R. S. R.

814. Optics of Finite Wave-Trains. D. Elert. *Ann. d. Physik,* 7. 1. *pp.* 65–102, *Oct.* 23, 1930.—A mathematical investigation of the reflection, penetration and transmission of waves at a plane parallel plate, when the secondary radiation of molecular resonators is taken into account. From the formulæ obtained the special case of reflection at a single interface is deduced. C. B. A.

815. Basic Formula for Variation Calculation. M. Herzberger. *Zeits. f. Physik,* 65. 9–10. *pp.* 700–704, 1930.—A general law connected with every homogeneous variation problem is given that, as in geometrical optics, allows all problems to be dealt with in a simple way which are only connected with the extremes of the variation problem and take no account of the question whether maximum or minimum. J. J. S.

816. Discovery of Corresponding Object and Image Points by Cardan's Problem. K. Hoecken. *Zeits. f. Instrumentenk.* 50. *pp.* 575–578, *Oct.*, 1930.—If distances *a* and *b* are marked along two lines inclined at 120° to represent the corresponding distances of object and image and the distant points connected, these lines will intersect at a point along the bisector of the angle at a distance from the origin equal to the focal length. The author shows how this construction can be varied and a nomogram obtained which will give the corresponding distances of the object and image in terms of the focal length and magnification. R. S. R.

817. Polarisation Interferometer and Its Uses. A. A. Lebedeff. *Rev. d'Optique,* 27. *pp.* 385–413, *Oct.*, 1930.—In the interferometer described the ordinary and extraordinary rays are not separated into two isolated pencils, but suffer only a little relative displacement, and for this purpose comparatively thin plates can be used. The rectilinear polarised rays produced by a Nicol prism fall on a crystalline birefringent plate of Iceland spar or quartz cut to give the greatest possible difference between the ordinary and extraordinary rays. The rays next pass through a half-wave plate which produces a rotation of 90° of the plane of polarisation of the rays, and then fall on a second crystalline plate of the same thickness as the first and with the same orientation. This reunites the two rays and gives generally an elliptically polarised vibration. The difference of phase is measured with the help of an ordinary compensator (quartz wedge, Babinet compensator, etc.). The object to be tested is placed between the half-wave plate and one of the birefringent plates. Plates are given to illustrate the general form of the apparatus. The arrangement described can be used to trace and measure slight slow variations of refractive index due to want of homogeneity. If a polarising microscope is added it can serve to measure the index of refraction of small grains by the immersion method and of separate crystals in mineral sections. R. S. R.

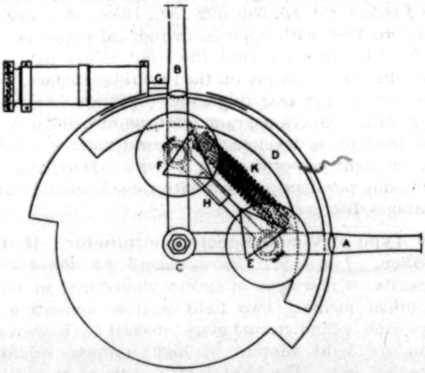
818. Anamorphosers. H. Bénard. *Rev. d'Optique,* 27. *pp.* 414–420, *Oct.*, 1930.—The general properties of systems of lenses are first considered when pairs of lenses are clipped together but crossed at different angles. These considerations are applied to a monocular or binocular deforming telescope, an arrangement first considered by Burch. The advantages and disadvantages of various types are discussed. The arrangement is then applied to photographic apparatus in which, by vertical magnification of a coast-line or distant or inaccessible objects on flat land or at sea, additional detail and information regarding relative dimensions may be obtained. R. S. R.

819. Parallax Panoramagrams for Viewing by Reflected Light. H. E. Ives. *J.O.S.A.* 20. *pp.* 585–592, *Oct.*, 1930.—A transparent refracting medium is provided with opposed cylindrical ridges on the front and back faces, of such curvature that the front ridges focus parallel rays, incident in any direction, sharply on the rear ridge surface. Photographic emulsion is placed on the rear ridge, and on it are impressed the linear elements of a parallax panoramagram, white paint being used as a diffusive backing. The negative is developed to a low density to retain the correct contrast after the light passes through it twice. Details are given of two methods for making parallax pictures with ridged celluloid films and their relative advantages discussed. R. S. R.

820. New Type of Visual Spectrophotometer. H. Buckley and F. J. C. Brookes. *Journ. Sci. Instruments*, 7. *pp.* 305–317, *Oct.*, 1930.—The paper describes a new type of spectrophotometer in which there are no moving optical media. Two light sources consisting of gas-filled tungsten lamps each behind ground glass are used. The ground glasses are used as secondary light sources of high uniform brightness (up to 400 candles per sq. in.). The photometric scale of the instrument is in terms of the voltage intensity relation of one of the light sources at a standard wave-length in conjunction with rotating sector discs of known transmission. The voltage intensity relation at other wave-lengths is shown to be deducible from that at the standard wave-length by simple computation. Special provision is made whereby the wave-length scale of the instrument is not affected by mechanical alteration in slit width. The Maxwellian method of view is utilised. The precision of the instrument is high, the average deviation from the mean of determinations of spectral transmission throughout most of the spectrum being about 0·5 %. AUTHOR.

821. Combined Use of Photoelectric Cell and Projection Microscope. A. Savage and M. C. Jamieson. *Canad. J. of Research*, 3. *pp.* 322–326, *Oct.*, 1930.—A method is described whereby the comparative areas of irregularly shaped microscopic objects may be rapidly determined. It consists of staining them with fuchsine and projecting their magnified images into a photoelectric cell insensitive to red light. The photoelectric current is inversely proportional to the sizes of the images and, at low magnifications, may be measured with a sensitive galvanometer. AUTHORS.

822. Quartz Monochromator and Its Spectral Transmission. W. E. Forsythe and B. T. Barnes. *Rev. Sci. Instruments*, 1. *pp.* 569–575, *Oct.*, 1930.—This monochromator has two Cornu prisms, 5 cm. high and 7·5 cm. along the base, which are mounted so that each remains in the position of minimum deviation as the instrument is rotated to bring different wave-lengths on to the observing slit. The arm A (see accompanying diagram) is fixed to the base of the instrument and the arm B is attached to this arm at the pivot C. The prisms E and F are mounted on tables, which in each case rotate about a vertical axis passing through the centre of the incidence face of the prism. The two prism tables are connected by an extension shaft so that as the arm B is rotated the centres of the two tables are always at the corners of an isosceles triangle with sides of constant length but with a varying base. The two parts of the extension shaft were ground together and the movable arm is held away from the fixed arm by a strong spring K. The screw G controls the position of the movable arm and is provided with a drum, the scale of which enables



readings to be made to 1 Å. in the ultra-violet range 3600 to 2600 Å. The second author has made a measure of the variation in the percentage transmission of the instrument at various wavelengths with the aid of a quartz spectrograph and thermopiles. It has been utilised by him for the study of the ultra-violet light of the sunlight lamp and for measuring the spectral transmission of various ultra-violet transmitting glasses.

W. C. S. P.

823. Influence of the Developer on the Properties of Photographic Plates. N. G. Perrakis. *Comptes Rendus*, 191. *pp.* 562–564, *Oct.* 6, 1930.—Shows that the Ilford special rapid panchromatic plate, when subjected to the treatment previously described [see Abstract 3709 (1930)], possesses two well-defined maxima situated at 6430 Å. and 4750 Å. The density which is a maximum at 6430 Å. decreases slowly to 5950 Å, thus producing a band of high sensitivity over this range. The other band, which is only 100 Å. wide, with its maximum at 4750 Å., is not so important, owing to its lower sensitivity. In order to illustrate the developer influences, two chemically different developers, A and B, are used, the other conditions being kept as constant as possible. A comparison of the density-wave-length curves obtained for the plates when developed in these solutions shows a higher density with A than with B, the curves remaining sensibly parallel. The connection between values of the contrast factor γ, for various wave-lengths, obtained with the two developers, is not so simple. With developer A the value of γ increases steadily from a value of 0·89 at 4000 Å. to 4·37 at 6800 Å., and then decreases rapidly to 1·20 at 7400 Å., it being 2·94 at 6400 Å. The increase of γ is more rapid for developer B, although it is lower at the commencement, and possesses the value of 0·55 at 4000 Å., has its maximum value of 3·30 at 6400 Å., and then decreases slowly at first and rapidly towards the end down to 0·50 at 7400 Å. Thus the curve for B crosses that for A at $\lambda = 4500$ Å. and 6500 Å. R. C. F.

824. Solarisation. Part III. H. Arens and K. Kipphan. *Zeits. f. wiss. Phot.* 28. *pp.* 229–238, *Oct.*, 1930.—Examines the blackening values and silver quantities obtained in the solarisation region when peptised silver bromide emulsions, as previously considered [see Abstract 3994 (1930)], are chemically and physically developed. Other quantities considered are covering power, number of silver grains, and grain size, whilst the relationships between the last two and the values of the blackening and silver quantities are examined. With chemical development blackening, silver quantity, number of grains and grain size decrease, and in the solarisation region the grains are always less developable in each case for equal times of development. The blackening, silver quantity and number of grains also decrease, in the solarisation region, with physical development, but the grain size appears to increase somewhat. Thus solarisation with physical development is apparently mainly due to a reduction in the number of grains. Chemical development produces an increase in covering power whilst physical development causes a decrease. The number of silver grains obtained with the maximum of the blackening curve for physical development is always approximately equal to the number of silver bromide grains obtained even with short development times. With chemical development the number of silver grains is always less than that of the silver bromide grains. Finally, the value of $1 \cdot 7 \times 10^{-6}$ cm. is given as the upper limit of the edge length of the sensitive nuclei. [See also Abstracts 1015 (1930) and 444 (1931).] R. C. F.

825. Adsorption as the Primary Occurrence of Photographic Development. P. Wulff and K. Seidl. *Zeits. f. wiss. Phot.* 28. *pp.* 239–291, *Oct.*, 1930.—Shows from an extensive adsorption examination, using sample emulsions, that organic developers, particularly hydroquinone, when used in alkaline solutions are adsorbed by silver bromide as negatively charged ions. This adsorption occurs before the developers show their reducing activities. These conclusions are arrived at from various experimental results which indicate that the isomers of organic developing materials which do not possess this power form, with silver ions when in alkaline solutions, salts which are difficult to dissolve. Resorcin, phloroglucin and *m*-amidophenol are three isomers mentioned and they further stop the developing action of hydroquinone, pyrogallol and *p*-amidophenol. Resorcin is adsorbed by silver bromide as anions when in alkaline solutions, this adsorption being reduced by Br^-, Cl^-, SO_3^{--} ions, and increased by Ag^+ and Tl^+ ions. This influence by the above ions of the adsorption of resorcin corresponds to their action in hydroquinone developer, the only exception being SO_3, for which no influence on the developer can be observed. It is not possible to say why the developer after adsorption only reduces the illuminated silver bromide particles. The results obtained confirm Sheppard's theory that photographic development is occasioned by the decomposition of an adsorption complex. R. C. F.

826. Reflection and Transmission of Light by Photographic Plates. D. B. McRae and R. C. Tolman. *J.O.S.A.* 20. *pp.* 565–572, *Oct.*, 1930.—In order to estimate the percentage of the incident light absorbed by an Eastman 40 plate, measurements were made of the light reflected and transmitted by means of a photographic method. Red, green, and blue light were used, as well as a band of light corresponding to the region of maximum sensitivity of the plate. The results show that the transmission varies considerably with the wave-length, whilst for the reflection no great change is indicated between red and green light; for the others the reflection falls to approximately one-half of this value. Further, provided the plates do not receive exposures sufficiently long to produce visible darkening before development, then no change in reflection or transmission can be observed. As is to be expected, the plate is a fairly efficient absorbing medium in the region of its greatest photographic sensitivity, some 66 % of the incident light being absorbed. R. C. F.

827. Calibration of Standard Lamps for Relative and Absolute Measurements. L. S. Ornstein, D. Vermeulen and E. F. M. v. d. Held. *J.O.S.A.* 20. *pp.* 573–584, *Oct.*, 1930.—The authors measured the spectral energy distribution in a tungsten lamp in the visible region in two ways: (1) The photographic, which is independent of temperature measurement. (2) The pyrometric, which depends on a temperature measurement with a Holborn-Kurlbaum pyrometer. An agreement of 1–2 % in the region 7000 Å. — 4000 Å. was found between the two methods. A method of temperature measurement is described which is based on the fact that the temperature of a black body is a function of the energy ratio of two colours. In the first case a thermopile is used for red and green, and in the second case a photo cell with valve amplifier is employed using red and blue. It is pointed out that this method is independent of any films of tungsten oxide on the glass. The absolute calibration of a lamp in two ways is then described. The first method involves the measurement of colour temperature at various currents by means of a pyrometer, a copper sulphate and quinine sulphate cell and a thermopile. In the second method the true temperature of the band lamp is found and the results calculated from the emissivity coefficients of tungsten.
W. C. S. P.

828. Tribo-Thermoluminescence. R. E. Nyswander and B. E. Cohn. *Phys. Rev.* 36. *pp.* 1257–1260, *Oct.* 1, 1930.—Glass, certain crystals and frits are rendered thermoluminescent by the process of grinding, emitting light of very low intensity. The phenomenon is observed not only in samples of low purity, but also in compounds prepared from chemically pure-grade materials. Quantitative measurements of light intensity were made by means of a polarisation photometer. The particles tested were graded in size by means of a set of screens ranging from 20 to 200 mesh. The results show that the quantity of emitted light depends upon the nature of the substance and the size of the particles, and diminishes slowly with the time after grinding. Common glass tubing crushed to various grain sizes emitted the maximum amount of light when the linear dimensions of the average mesh size fell between 0·015 cm. and 0·025 cm. respectively. [See also Abstract 2811 (1930).] AUTHORS.

829. Polarised Fluorescence of Solutions of Rhodamine B and Uranine. E. Merritt and D. R. Morey. *Phys. Rev.* 36. *pp.* 1386–1393, *Oct.* 15, 1930.—The results on the polarisation of the fluorescence from glycerin solutions of uranine and rhodamine B show that the degree of polarisation is the same throughout any one band, thus confirming the results of Wawilow and Lewschin and of Pringsheim and Wawilow [see

Abstracts 1847 (1923)*and 2596 (1926)] and confirming the view that a fluorescent band is to be regarded as a unit. This is further supported by the fact that in some concentrations there are two bands with uranine solutions in which the polarisation is the same throughout each but different as between the two. J. E.

830. Measurements of Fluorescence of Cellulose Acetate and Nitrate and Gelatin in Ultra-Violet Light. J. G. McNally and W. Vanselow. *Am. Chem. Soc., J.* 52. *pp.* 3846–3856, *Oct.*, 1930.—Results are presented showing that (*a*) the fluorescence excited by ultra-violet light in cellulose acetate and nitrate films depends on the micellar structure; (*b*) when the micellar structure is similar, acetates resemble each other when they are alike in chemical structure rather than in colloidal properties; (*c*) the fluorescence of cellulose acetate sols is independent of the colloidal properties; (*d*) the fluorescence of gelatin sols decreases during the part of the hydrolysis causing a change of micellar magnitude and increases later because of some secondary change. It appears that the amount of strain in a cellulose acetate film or nitrate film affects the fluorescence. J. E.

831. Influence of Foreign Gases on the Selective Reflection of the Mercury Resonance Line. O. Schnettler. *Zeits. f. Physik*, 65. 1–2. *pp*. 55–66, 1930.—The effect of foreign gases on the selective reflection of the line 2536·7 by mercury vapour at high pressures is different from their effects on fluorescence. In the former case the effects are independent of the nature of the added gas as long as the number of collisions is the same. It is supposed that in the case of selective reflection the collisions are not those of the "second kind" but result in a broadening of the region of selective absorption. J. E.

832. Absorption Spectrum of Lithium Vapour. R. W. France. *Roy. Soc., Proc.* 129. *pp*. 354–360, *Oct.* 1, 1930.—The absorption spectrum of lithium vapour has been photographed down to 2250 Å., *i.e.*, to the limit of the principal series, with a mean error of ± 0·01 Å. With the vapour at a temperature above 950° C. a complicated many-lined spectrum appears in the neighbourhood of 3233 Å., but no order or band head is discernible. Two lines of the series (1*s*—*md*), not in accordance with the selection principle, have been measured, *viz.*, (1*s*—3*d*) at 3195·716 Å., and (1*s*—4*d*) at 2729·706 Å. The limit of the principal series, derived by application of Hick's formula, is at 2298·837 ± 0·015 Å. H. F. G.

833. Line Spectra of Ions in the Solid State in the Visible and Ultra-Violet Regions. Absorption Spectrum of Gadolinium Bromide Hexahydrate. S. Freed and F. H. Spedding. *Am. Chem. Soc., J.* 52. *pp*. 3747–3756, *Oct.*, 1930.—It is shown on the basis of electronic structure and the screening effect of the outer complete electron shells on the electrons of the incomplete 4_4 shell, that the absorption spectra of the rare earths should resemble the line spectra of monatomic gases, that the sharpness of the lines should increase at lower temperatures, and that in view of the less energy required to affect electrons in the 4_4 shell it should be possible to correlate changes therein with such magnitudes as heats of solution, etc. The first two of these deductions are illustrated by the absorption spectrum of gadolinium bromide hexahydrate, which has been measured at the ordinary temperature (53 lines), and at the temperatures of liquid air (67 lines) and hydrogen (46 lines). The lines are all in the ultra-violet except a few in the visible at the lower temperatures. All are very sharp, sharpness increasing as temperature decreases. The spectrum shows line for line correspondence with that of the chloride [see Abstract 651 (1930)], but the components of the multiplets are separated a little further. Both spectra consist of groups of lines, each of which may be regarded as corresponding to one line of gaseous Gd+++ decomposed by the electric field due to the neighbours of the Gd+++ ions in the crystal lattice. C. A. S.

834. Ultra-Violet Absorption of Alkaline and Alkaline Earth Halides in Aqueous and Non-Aqueous Solutions. E. Lederle. *Zeits. f. phys. Chem.* 10. *Abt. B.* 2. *pp.* 121–141, *Oct.*, 1930.—The electronic affinity spectra of the halogen ions and the influence upon them of temperature and solvent are described, and the experimental data found to be in agreement with the assumptions of Franck and Scheibe. The halides of the elements of the second sub-group of the periodic system are only partially dissociated in non-aqueous solution, since their absorptions are due to the molecules. Supported by Terenins' observations it appears probable that the photo-reaction for HgI_2 produces HgI + I, whereby both dissociation products can occur in the activated state. H. H. Ho.

835. Absorption of the Fine-Structure of the H_α Line in Excited Hydrogen. V. v. Keussler. *Ann. d. Physik*, 7. 2. *pp.* 225–256, *Oct.* 31, 1930.—The suggested metastability of the $2S_{\frac{1}{2}}$ state of hydrogen would result in a much stronger absorption of the short-wave components of the Balmer series doublets than of the long-wave components. The careful measurements of the relative absorptions of the components of the H_α doublet, in excited hydrogen, described here were made at very low pressures and small current densities and at liquid air temperature. The absorption tube contained atomic hydrogen pumped in from a side tube in which the breaking-up of the hydrogen molecules was effected. As absorption background light, the broadened H_α line itself was used to facilitate the separation of the different order spectra produced by the Lummer-Gehrcke plate. It was found that the ratio of the absorption coefficients of the two H_α components was independent of the pressure and current density in the discharge tube, indicating the absence of the metastability in question. The actual value of the ratio agreed with that deduced by Sommerfeld and Unsöld assuming a population of the component levels of the lower term of H_α, corresponding to their statistical weights. Intensity ratio: $\frac{\text{short wave component}}{\text{long wave component}} = 0{\cdot}76$. W. S. S.

836. Absorption of Light by Gaseous, Liquid and Solid Xenon. J. C. McLennan and R. Turnbull. *Roy. Soc., Proc.* 129. *pp.* 266–283, *Oct.* 1, 1930.—The absorption of light by liquid and gaseous xenon has been studied in order to see what relation the absorption bears to the resonance lines of this element. The resonance line used is that at 1469 Å. At 2 mm. pressure gaseous xenon absorbed radiation of this wave-length, but as the pressure was increased the absorption rapidly widened out to a band which had a width of 156 Å. at 50 atmospheres. The absorption band develops asymmetrically on the long wave-length side. It is pointed out that mercury vapour behaves in the same way, and that in both cases the band is developed about a resonance line originating in an electronic transition from a singlet to a triplet energy level $h\nu_1 = {}^1S_0 - {}^3P_1$. With liquid xenon it has been possible to measure the long wave-length limit of

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the absorption band associated with the line 1469 Å. The remarkable result was obtained that as the temperature was lowered from 10° to − 10° C., the absorption band widened out to 2558 Å., and then as the pressure was further lowered it narrowed again until at − 110° C. the limit to the absorption on the long wave-length side was at 1783 Å. F. J. W.

837. New Ultra-Violet Spectrum of Helium. J. J. Hopfield. *Astrophys. J.* 72. *pp.* 133–145, *Oct.*, 1930.—The resonance series of helium in the ultra-violet has been extended to ten members. Some of the lines have been measured in orders as high as the fifth and with considerable accuracy. Continuous bands have been found superimposed upon atomic lines. Because of these bands the first two lines of the resonance series appear very broad and asymmetrically self-reversed at 1-mm. pressure. Intense continuous spectra of molecular origin have been discovered in the region between λ500 and λ1125. This is the only strong continuous spectrum that has yet been found in the region λλ500–900. To account for the observed facts two distinct species of helium molecules are postulated. The first absorption spectra to be obtained in the region λλ500–900 are recorded. These are shown for O_2 and H_2. AUTHOR.

838. Anomalous Dispersion in Excited Gases. Part V. Negative Dispersion in Excited Neon. H. Kopfermann and R. Ladenburg. *Zeits. f. Physik*, 65. 3–4. *pp.* 167–188, 1930.—When the current density in the positive column of a neon discharge is increased an increase at first takes place in the anomalous dispersion at the reddish-yellow s—p lines, and it is found that all lines connected with the same lower s state behave in the same way, which implies a rise of atomic density N_s in the s state. If, however, the current density is increased above about 0·1 amp./sq. cm. (at 1 mm. pressure), the increase in the a.d. begins to fall off slowly, and in a different manner for the different lines s_5—p_{10}, p_9, p_8 . . . down to p_2. This is explained by gradual increase at different rates of the atomic densities $N_{p_{10}}$, N_{p_9} . . . in the p states, and the resulting negative dispersion produced. By using special precautions, including the employment of a special quartz tube with cooling arrangements, the current, which in previous experiments did not exceed 50 mA was increased to 700 mA, tube diameter 0·8 cm. The above explanation was confirmed by an investigation of the reversal of the neon lines. At the highest current the N_p values approach a saturation value, and there appears to be statistical equilibrium between the atomic densities in the different states, and the exciting and destroying electrons. Θ, the specific temperature, seems to be the same for the states p_{10}, p_9, p_8, p_6 and p_4, and at 1 mm. pressure to be about 23,000°. For the excitation of the s_5 state from the normal state p_0 a specific temperature of from 18,100° to 21,500° is calculated, a little smaller than the above value for the p states. [See also following Abstract.] H. N. A.

839. Anomalous Dispersion in Excited Gases. Part VI. Control Experiments Relating to the Existence of Negative Dispersion. R. Ladenburg and S. Levy. *Zeits. f. Physik*, 65. 3–4. *pp.* 189–206, 1930.—The explanation given in Part V [see preceding Abstract] is here supported in two ways. Anomalous dispersion is shown to exist in the neon line 7059(p_{10}—s_1'') and its absorption is measured. This becomes marked in the critical current region and then increases rapidly with the current. Secondly the rise in intensity of the s—p neon lines has been studied. Investigation of the distribution of intensity in the interior of these lines, derived from a short and a very long gas layer, by means of a Perot-Fabry etalon shows that the distribution depends solely on the Doppler effect, and that the temperature of the emitting atoms, with a current of 100 mA, is practically the same as that of the cooling water employed. Using these data, and the values of the anomalous dispersion, it is possible to calculate approximately from the rise in the intensity the rise in the density of the p_k atoms with the current; and it appears at least qualitatively that the results agree with those obtained in Part V; that is to say, negative dispersion takes place with high current densities. H. N. A.

840. Second Spark Spectrum of Krypton. D. P. Acharya. *Indian Journ. Phys.* 5. *pp.* 385–405, *Oct.* 1, 1930.—The lines marked " 2 " in the list published by L. and E. Bloch and Dejardin have been supplemented by measurements on two quartz spectrographs. Tables of values are given and analysis effected with the aid of similar spectra. It is concluded that these lines are due to doubly ionised krypton. F. S.

841. Oxygen Spectrum (OI). F. Paschen. *Zeits. f. Physik*, 65. 1–2. *pp.* 1–3, 1930.—Reports the observation of three red lines in the oxygen spectrum OI, corresponding to the transitions from the second ground term $(2p)^4\,{}^1D_2$ to the deepest ground term $(2p)^4\,{}^3P_{2,\,1,\,0}$. A high-current density was used. W. S. S.

842. Analysis of the S_2 Spectrum. R. Rompe. *Zeits. f. Physik*, 65. 5–6. *pp.* 404–429, 1930.—Using the results of Teves, the electron spring for the bands classified by Rosen has been found to be ${}^1\Sigma_0 - {}^1\Pi_1$. Some of S_2 bands found by Gilles have been arranged in a scheme; the new bands are explained as due to passages from the same ground state ${}^1\Sigma$. Five resonance series of S_2(Hg2967, 3020, 3126, 3131, 3655) are arranged in the band head scheme. It is shown that for the first four the number of the anti-Stokes members agrees with the arrangement, but this is not the case for 3655. The distribution of intensity as given by the resonance series differs somewhat from that to be expected from Condon's considerations. The arrangement of the lines in the component bands is given for the series 3131 and 2967 and the distribution of intensity is discussed. The behaviour of the resonance series of S_2 and Se_2 was investigated when other gases were added (N_2, He). H. N. A.

843. Phosphorus Hydride Band at 3400 Å. R. W. B. Pearse. *Roy. Soc., Proc.* 129. *pp.* 328–354, *Oct.* 1, 1930.—Considerable data has been obtained relating to the transition ${}^3\Pi \rightarrow {}^3\Sigma$ by photography under high dispersion and analysis into 27 branches of the band at 3379–3476 Å., attributed by Geuter to a phosphorus hydride. The nature and structure of the band confirm that it is due to a hydride, and it resembles the NH band at 3360 Å. in having a strong central maximum of intensity and a symmetrical distribution of the lines, but the series emerging at the extremities appear as doublets and there are a larger number of secondary maxima. The observed separations derived by resolution of the fine structure arising from the ${}^3\Sigma$ level are in agreement with the value obtained from Kramer's theoretical formula. The ${}^3\Pi$ levels are inverted; the electronic energy separations between the three component levels are not equally spaced, since, approximately, ${}^2\Pi_2 - {}^2\Pi_1 = -121$ cm.$^{-1}$ and ${}^2\Pi_1 - {}^2\Pi_0 = -111$ cm^{-1}. H. F. G.

844. Arc Spectrum of Carbon (CI). F. Paschen and G. Kruger. *Ann. d. Physik*, 7. 1. *pp.* 1–8, *Oct.* 23, 1930.—Measurements as far as 1112 Å. have been made in the vacuum region, using two concave gratings of 1 m. radius. The lines are tabulated and their series designations given. The analysis is made with the aid of that of Fowler and Selwyn, and comparison made with Hopfield's measurements. F. S.

845. Comet Tail Bands of Carbon Monoxide. L. R. Maxwell. *Frank. Inst., J.* 210. *pp.* 427–436, *Oct.*, 1930.—A form of discharge tube is described in which the bands are excited by means of electrons of known energy, the spectrum being photographed in a direction at right angles to an applied electric field. If the emitters are charged, the spectrum lines will be lengthened, and these emitters are thus found to be positive ions. Helium at a pressure of $2\cdot8 \times 10^{-3}$ mm. when introduced into the tubes caused the comet tail bands to disappear. F. S.

846. Spectrum of Doubly Ionised Thallium. P. Pattabhiramayya and A. S. Rao. *Indian Journ. Phys.* 5. *pp.* 407–416, *Oct.* 1, 1930.—An account of experimental work which has led to an extension of our knowledge of the second spark spectrum of thallium. In accordance with the theory of spectra developed by Hund, it has been shown that the spectrum consists of two parts, an ordinary doublet spectrum, and a quartet, doublet spectrum, with the lowest term, the metastable inverted ^{2}D. The two types of ion on which these two spectra are built are (d^{10}) and (d^9s) which spectroscopically are terms of the type ^{1}S and ^{3}D and ^{1}D. A catalogue is given of all the lines with their designations. [See also Abstract 3236 (1928).] AUTHORS.

847. Natural Breadth of Spectral Lines in the Radiation of the Harmonic Oscillator. V. Weisskopf and E. Wigner. *Zeits. f. Physik*, 65. 1–2. *pp.* 18–29, 1930.—In the previous paper [see Abstract 154 (1931)] on the derivation of line breadth in accordance with Dirac's radiation theory, it was assumed that the line breadth was small compared with the principal frequency and also small compared with the difference between successively emitted frequencies. In the oscillator for which all the frequencies are the same, the latter assumption no longer holds. The present calculations extend the Dirac theory to this case and show that the line breadth of the harmonic oscillator agrees completely with that computed on the classical theory. W. S. S.

848. Alterations in the Distribution of Intensity in a Resonance Spectrum. L. Natanson. *Zeits. f. Physik*, 65. 1–2. *pp.* 75–83, 1930.—The effect of pressure on the distribution of intensity in Te and Se resonance spectra, excited by the mercury arc, has been investigated. Tables are given for the Se spectrum, showing the relative intensities of the components of certain doublets at 4 mm. pressure, at 35 mm. pressure, and at 35 mm. with increased absorption in Se vapour. It is shown that the relative intensities are affected considerably by the change in pressure in many instances, and that the changes are not always due to change in the absorption. Changes due to alteration in temperature were investigated in Te vapour. H. N. A.

849. Quenching of Mercury Resonance Radiation. Part I. The Saturated Hydrocarbons. J. R. Bates. *Am. Chem. Soc., J.* 52. *pp.* 3825–3832, *Oct.*, 1930.—Reference is made to the work of Taylor and Hill, Bonhoeffer and Harteck, and to the author's previous work [see Abstract 1358 (1929)] on hydrogen and excited cadmium atoms. Results are here given for the quenching of mercury resonance radiation by methane, ethane, propane and butane. Values for the effective collision cross-section are calculated. Methane quenches mercury resonance radiations in the same way as the more inert type of gas molecule and this is in agreement with the properties of the benzene molecule. Methane quenches to the metastable level. J. K.

850. Measurements of the Light Yield in the Excitation of the Mercury Spectrum by Electron Collision. W. Hanle and W. Schaffernicht. *Ann. d. Physik*, 6. 8. *pp.* 905–931, *Oct.* 10, 1930.—A photoelectric cell method was used to determine the intensity of the light emitted in various mercury lines excited by electron collision, the electron velocity equalling 60 volts in all the measurements. The experimental arrangements were specially designed to give absolute values and the results are expressed in terms of the "light yield," the ratio of the number of light quanta emitted, to the total number of collisions between electrons and mercury atoms. For this ratio the values obtained were 2·7/1000 for the line 4348, 5·4/1000 for 4358, 4·4/1000 for 5461, 0·85/1000 for 5675, 3·4/1000 for 5769 and 6·9/1000 for 5789 and 5790 together. The number of collisions was computed from the known effective cross-section of mercury atoms with respect to electrons. A description is also given of a photoelectric method for determining the optical excitation function for lines excited by electron collision, and experimental excitation curves for the mercury lines 4348, 4358, 5461 are reproduced in the paper. W. S. S.

851. Collisions of the Second Kind between Electrons and Excited Mercury Atoms. G. D. Latyscheff and A. I. Leipunsky. *Zeits. f. Physik*, 65. 1–2. *pp.* 111–123, 1930.—The dependence of the probability of this type of collision on the velocity of the electrons is investigated. The curve for the probability is exactly similar to the analogous curve for collisions of the first kind. The experiments were carried out on mercury atoms in the metastable state 2^3P_0, and the transition into the state 1^1S was followed. The probability was a maximum for electron velocities excited by 2·8 volts applied potential. The absolute value of the probability (maximum value) is 0·7 %. A. C. M.

852. Origin of the Bands in the Spectrum of Mercury Vapour. S. Mrozowski. *Phys. Rev.* 36. *pp.* 1168–1171, *Oct.* 1, 1930.—Arguments of Rollefson [see Abstract 3426 (1930)] admitting the existence of molecules of small energy of binding in mercury vapour, are criticised. It is shown that the experimental facts lead to the following conclusions: (1) That absorption is due to the molecules which exist before irradiation of the vapour; (2) probably all absorption bands have the same origin; (3) the bands are due to molecules with great energy of binding (17 kcal/mol); and (4) the emission bands lying in the region of the absorption bands are emitted by the molecule in returning to its normal electronic level. A new observation is made of shaded absorption bands at 2267 and 2247 Å. AUTHOR.

853. Dispersion of Mercury Vapour. R. Ladenburg and G. Wolfsohn. *Zeits. f. Physik*, 65. 3–4. *pp.* 207–208, 1930.—The authors' measurements of the optical dispersion of mercury vapour indicate that the life-period of the $^3P_1$ condition, *viz.* $(1·14 \pm 0·02)10^{-7}$ is about 14 %

greater than that hitherto accepted on the basis of Wien's measurements. The significance of the third characteristic frequency introduced into the dispersion formula derived from the authors' measurements [see Abstract 128 (1931)] is discussed with reference to Foard's measurements of the critical potentials of mercury vapour. Then latter measurements indicate the occurrence of a limit of the principal series at 1117 Å, compared with the authors' determination at 1190 Å. This line is probably chiefly attributable to simultaneous quantum leaps of both valency electrons. J. S. G. T.

854. Raman Effect in Optically Active Liquids. A. Kastler. *Comptes Rendus*, 191. *pp*. 505–566, *Oct*. 6, 1930.—Natural light (which can be regarded as two oppositely rotating circular polarisations of the same intensity and with no coherence of phase) was scattered at right angles in left-handed and in right-handed pinene. As expected, there was no difference. Circularly polarised light was then used. Again there was no difference. It is thought that possibly there might be some difference introduced into the fine-structure of Raman lines. A. C. M.

855. Raman Effect in Crystalline and Dissolved Sulphates and Carbonates. N. Embirikos. *Zeits. f. Physik*, 65. 3–4. *pp*. 266–269, 1930.—Using the powder method, the inactive frequencies are investigated for crystal powders of carbonates and sulphates, and the results are compared with the values for the same substances in solution. In all cases the frequency in the crystal is higher than when in solution. Also in the cases of lithium sulphate and magnesium sulphate the increase of frequency with concentration is clearly shown. A. C. M.

856. Raman Effect in Crystals. C. Schaefer, F. Matossi and H. Aderhold. *Zeits. f. Physik*, 65. 5–6. *pp*. 289–318, 1930.—The Raman spectra have been photographed and recorded for XY_3 groups (carbonates, nitrates, chlorates and bromates), and for XY_4 groups (sulphates, selenates, ammonium phosphate and ammonium chloride (NH_4 group)). In the XY_3 groups, the inactive frequency is always extremely strong, while the vibration parallel to the axis is almost always missing. In the XY_4 groups there are four frequencies, two of them inactive. In ammonium chloride only one frequency appears. In gypsum a sharp doublet appears in addition to the usual four sulphate frequencies, which is attributed to the water of crystallisation. A. C. M.

857. Raman Effect with Cadmium Arc Excitation. P. Krishnamurti. *Indian Journ. Phys*. 5. 6. *pp*. 587–591, *Oct*., 1930.—A cadmium arc is made using a 50 % tin-cadmium alloy. The advantage is that it gives strong lines—5086 and 6439 Å. which are of longer wave-length than the mercury arc lines usually employed. 6439 might be used with orange or red substances. The arc was used with ferrous and nickel sulphates, and failed to give any lines, confirming the previous experiment when a mercury arc was used. Sulphur gave four lines. A. C. M.

858. Frequencies Characteristic of Radicals in the Raman Effect. N. N. Pal and P. N. Sen Gupta. *Indian Journ. Phys*. 5. 6. *pp*. 611–614, *Oct*., 1930.—Certain frequencies persist in different compounds having one radical in common, to which the frequencies are consequently attributed. But it is important to note that the strength of the binding between the components of the radical does not necessarily remain the same in all cases. This is illustrated by comparing the vibration frequencies of the CN group. CN linked to an aliphatic carbon has approximately the same frequency whatever the nature of the aliphatic radical, but it has another value when attached to an aromatic group. Again in the metal cyanides there is one value for divalent metals and another for monovalent ones. It is suggested that the oscillation frequency is determined by the masses of the C and the N, and by the forces of binding, to which not only the charges on the nuclei, but also the electronic configurations will contribute. If the latter is changed, the frequency will be modified. A. C. M.

859. Benzene Ring and Raman Effect. S. Bhagavantam. *Indian Journ. Phys.* 5. 6. *pp.* 615–631, *Oct.*, 1930.—The theory of the vibration of an elastic solid circular ring is used to deduce the vibrations of a hexagonal ring. There should be 12 oscillations; six flexural (3 in the plane of the ring, 3 perpendicular) and six extensional oscillations are anticipated. The frequencies found by the Raman effect in benzene are then attributed as follows: all above 1500 cm.$^{-1}$ to the hydrogen atoms, 992 to an inactive oscillation in which all six carbon atoms move tangentially, three in one phase and the alternate three in the other phase. This frequency naturally appears in all derivatives of benzene. 607 is attributed to the gravest extensional mode ("breathing" of the carbon atoms in and out as a whole). 851 and 1181 are two asymmetrical modes of the extensional type. By making a very long exposure, six new Raman lines of very low intensity have been observed. The infra-red absorption frequencies above 1100 have been coordinated on these lines. A. C. M.

860. Atomic Analysis by X-Ray Spectroscopy. T. H. Laby. *Faraday Soc., Trans.* 26. *pp.* 497–509; *Disc.*, 514–516, *Aug.*, 1930.—Considers in detail analysis by X-ray spectroscopy after recalling certain characteristic features of the chemical and optical spectroscopic methods of analysis. After illustrating the simplicity of X-ray spectra the author deals with the principles of X-ray spectroscopic analysis, identification of lines, discovering of elements by this method, and excitation of X-ray spectra. Then follows a discussion of the excitation voltage, spectrometry and photography, the suggested exposures and variations in exposure necessary for variation of mixture being given. Sensitiveness, experimental control and interpretation of spectra, are next dealt with and a brief comparison of the X-ray and optical spectroscopes is made. Finally, the principles of the method, range of elements to which the methods are applicable, quantitative nature of the spectrum, and sensitiveness of methods and certainty in the identification of the lines are considered. In the *Discussion*, **J. J. Fox** briefly dealt with the suitability of the three methods of analysis and showed that each one had its own spheres of use. **B. S. Evans** supplemented the results given for the estimation of very small quantities of impurities, and also quoted one case of failure in which tin was not detected although known to be present. **D. E. Thomas** stated that the failure to detect tin was due to insufficient knowledge of the methods at the time. **D. M. Smith** asked if visual observations could be used with any degree of accuracy. R. C. F.

861. Determination of Potassium by X-Ray Spectroscopy. J. T. Calvert. *Faraday Soc., Trans.* 26. *pp.* 509–514; *Disc.*, 514-516, *Aug.*, 1930.—Describes a simple X-ray method for the determination of potassium in soil samples. A known quantity of manganese dioxide is added to the soil sample and the intensities are compared of the potassium $K\alpha_1$ and the manganese $K\beta_1$ lines excited by X-rays of shorter wavelengths. Manganese is added to the soil to provide reference lines. The methods of quantitative X-ray analysis, considering the determination of potassium in metals, are discussed. In the *Discussion*, **R. Robertson** stressed the possible importance of the author's method in agricultural chemistry, and **B. S. Evans** asked how manganese already present in the soil affected the result when manganese was added to produce the reference lines. R. C. F.

862. High-Potential X-Ray Tube. C. C. Lauritsen and B. Cassen. *Phys. Rev.* 36. *pp.* 988–992, *Sept.* 1, 1930.—An account is given of further development work on the high potential X-ray tube at the California Institute of Technology. Details of the construction of the tube and its housing are presented. The housing, which is a concrete structure erected on the floor of the high potential laboratory, makes it possible to operate and make observations at close range. The tube has been equipped with a hot kathode and a tungsten target, thus rendering it more suitable for spectrographic work. High-speed kathode rays outside of the tube have been obtained by replacing the target by thin windows of mica or metal. Continuous operation is possible over a period of several hours at 600 kV and with a space current of 3 to 4 mA. A comparison between different types of high potential X-ray tubes and of different methods of operation is contained in the discussion. AUTHORS.

863. Efficiency of Production of X-Rays. W. W. Nicholas. *Bureau of Standards, J. of Research*, 5. *pp.* 843–865, *Oct.*, 1930.—The various corrections necessary for an estimate of efficiency of production E_c of continuous spectrum X-rays are carefully considered. These include corrections for absorption (including absorption in the antikathode), reflection of kathode rays at the focal spot, asymmetric spatial distribution of X-ray intensity, and allowance for characteristic ray energy. Applying these corrections to some data by Rump [see Abstract 2916 (1927)], E_c for a tungsten antikathode at a voltage $V = 40$ kV is found to be $0{\cdot}0039$. It is pointed out that E_c cannot yet be accurately estimated for a wide range of voltage. Present knowledge of secondary processes in gasfilled tubes is so limited as to make it inadvisable to attempt to use these tubes for an exact estimate of E_c. The bearing of the Thomson-Whiddington constant on the generation of X-ray energy is pointed out, and an explanation given for Ulrey's results indicating a certain degree of periodicity in the dependence of efficiency on atomic number. It is shown, on the basis of Rump's data, that the continuous spectrum intensity generated inside an antikathode and radiated at an angle $\psi = 90°$ with the kathode stream is proportional to $V^{3/2}$, at least for tungsten and $V > 40$ kV. A general formula for the spectral intensity distribution of this radiation is given, as well as a means for estimating its variation with ψ; absorption in the antikathode is described quantitatively; the proportion of K characteristic rays for tungsten is found. There is thus obtained a complete description of the intensities obtainable outside X-ray tubes for a wide range of practical conditions. AUTHOR.

864. Improved Form of Standard Ionisation Chamber. L. S. Taylor and G. Singer. *Bureau of Standards, J. of Research*, 5. *pp.* 507–516, *Sept.*, 1930.—A modification of the open-air parallel plate ionisation chamber, readily portable and adapted to field use, is described. In this chamber, narrow guard plates are supplemented by a system of 10 guard wires across the ends of the chamber. The wires are so spaced that X-ray scattering from them is negligible. By this means a uniform electrostatic field between electrodes is obtained without the use of wide guard plates and the large plate-to-shield spacing necessary in the primary standard. This design has permitted a decrease in the volume and weight of the secondary standard by a factor of 15. The results of direct comparisons between this chamber and the primary standard are given and indicate that the Röntgen can be reproduced by the former with the same accuracy as the primary standard. The problem of diaphragming is identical for the two chambers, and for a given tube the same inverse power law holds for both. Like the standard chamber, the new chamber does not require that corrections be made for differences in X-ray quality. Any of the usual electrostatic measuring systems may be used with this chamber, although for precise work a null or current compensation system is desirable. It is expected that this type of chamber will be found useful in the international comparisons of the Röntgen now pending, for which purpose the " fingerhutkammer " is generally inadequate. AUTHORS.

865. Energy of Kα_3 of Copper as a Function of Applied Voltage. J. W. M. du Mond and A. Hoyt. *Phys. Rev.* 36. *pp.* 799–809, *Sept.* 1, 1930.—With a double crystal spectrometer of special design here briefly described the following questions were investigated with a view to determining the origin of the satellite Kα_3 of copper. (1) Dependence of intensity of satellite Kα_3 of copper on voltage with constant current. (2) Dependence of intensity of parent line Kα_1 of copper on voltage with constant current. (3) Ratio of intensities of satellite to parent. (4) Dependence of satellite intensity on current at constant voltage. The conclusions are (1) that the satellite is excited at a voltage differing from the excitation voltage of the parent line by too small an amount to be measured with certainty (less than 200 volts). (2) That the ratio of intensities of α_1 to α_3 as estimated from the *areas* of the spectral line structures is about 1 : 120. (3) That the intensity of the satellite Kα_3 of copper is strictly proportional to the current at constant voltage. These facts seem to invalidate the Wentzel-Druyvesteyn " spark line " hypothesis as an explanation of Kα_3 of copper. Richtmyer's " double jump " hypothesis [see Abstract 666 (1930)] remains tenable. In addition, a doublet structure (separation of components about 2 X.U.) in Kα_3 of copper was observed (in accord with the doublet structure of this satellite in elements of lower atomic number). AUTHORS.

866. Intensity of X-Ray Satellites. F. K. Richtmyer and L. S. Taylor. *Phys. Rev.* 36. *pp.* 1044–1049, *Sept.* 15, 1930.—By means of the two-crystal ionisation spectrometer measurements have been made of the wave-lengths and intensities relative to Kα_1 of the satellites K$\alpha_{3,4}$ of Cu(29). K$\alpha_{3,4}$ has characteristics of a doublet and is separated, photographically, for elements below Sc(21), but is unresolved for elements of higher atomic number. The greater resolving power of the two-crystal spectrometer shows that this " doublet " contains, probably, more than the two components Kα_3 and Kα_4, the wave-lengths of which latter were found, respectively, to be 1531·15 and 1530·15 X.U. The intensity of either of these components, at 40 kV, is of the order of 0·25 % of the intensity of Kα_1. A similar study of the K$\alpha_{3,4}$ doublet of Ni(28) suggests that this doublet may contain four components. AUTHORS.

867. Measurements in the Soft X-Ray Region. M. Söderman. *Phil. Mag.* 10. *pp.* 600–616, *Oct.*, 1930.—An improved vacuum spectroscope with grating of 1800 lines per mm. is fully described. Calibration is based on Larsson's value for CuLα (13·306 Å.). The following values for the wave-lengths and critical potentials were obtained: (Kα lines) Na 11·885, 1038; F 18·275, 675·5; O 23·567, 523·8; N 31·557, 391·2; C 44·54, 277·2; B 67·71, 182·3; Be 115·7, 106·7: (K$\alpha_{1, 2}$ lines) Al 8·323, 1483; Mg 9·874, 1250: (K$\alpha_{3, 4}$ lines) Al 8·262, 1494; Mg 9·799, 1260. (K$_\beta$ line) Al 7·952, 1552. For Al, Mg, Na and F the probable error is 0·02–0·03 %, for O 0·06, and rises to 0·15 % for Be. C. A. S.

868. Precision Measurements in the K and L Series of the Elements Copper, Tin and Erbium to Rhenium. Ina Wennerlöf. *Arkiv f. Mat., Astron. och Fysik, Stockholm*, 22. A. 8. [20 *pp.*], 1930. *In German.*—A description of a precision spectrometer and the results of measurements of the wave-lengths of certain elements as above. W. V. M.

869. X-Ray Spectrometer Measurements of the L Absorption of the Elements 74 Tungsten to 92 Uranium. A. Sandström. *Zeits. f. Physik*, 65. 9–10. *pp.* 632–655, 1930.—A Siegbahn tube spectrometer was employed in the investigation. The three L edges were determined for the elements tungsten 74 to bismuth 83, thorium 90 and uranium 92. To obtain sharp edges the thickness of the specimen is critical and a formula is developed for calculating the best thickness. Line absorption could also be observed and in some cases measured. The results are discussed and compared with earlier measurements. W. S. S.

870. Structure of K Radiation in Region of Very Soft X-Rays. M. Söderman. *Zeits. f. Physik*, 65. 9–10. *pp.* 656–661, 1930.—Microphotometric measurements of a number of X-ray lines obtained with the new Upsala grating, are reported. The investigation is concerned with the point that whilst very short wave-length optical lines are obtained as sharp lines, X-rays in the same wave-length range give only diffuse lines to which some workers attribute structure. The present measurements show continuous density curves and indicate that the suggested "components" of the lines CKα, BKα and BeKα are not real. The difference in sharpness between optical lines and X-ray lines in the same wave-length region is to be attributed to the difference in the state of the emitting matter, free ionised atoms for optical lines, and the solid element for X-rays. W. S. S.

871. Relative Intensities of X-Ray Lines in the Tantalum L-Spectrum. V. Hicks. *Phys. Rev.* 36. *pp.* 1273–1284, *Oct.* 15, 1930.—The relative intensities of 17 lines in the L spectrum of tantalum were investigated by the ionisation spectrometer. The paper contains a description of experimental precautions and results. W. V. M.

872. Some Series in the Extreme Ultra-Violet Spark Spectra of Copper. F. C. Chalklin. *Phil. Mag.* 10. *pp.* 711–721, *Oct.*, 1930.—Compares the critical potentials of soft X-ray excitation of copper with the spectroscopic work of Millikan on the vacuum spark lines of copper; a number of the levels indicated by the spectra appear to agree fairly closely with levels indicated by the critical potential method. It appears probable that between 300 Å. and 1000 Å. there is something in common between the excitation of the copper in Millikan and Bowen's vacuum sparks and the excitation of solid copper by electronic bombardment in the soft X-ray experiments of Richardson and the author. H. N. A.

873. Scattering of X-Rays by Copper and Silver. A. A. Rusterholz. *Zeits. f. Physik*, 65. 3–4. *pp.* 226–232, 1930.—The scattering functions of copper and silver have been determined from the intensities measured on Debye-Scherrer diagrams obtained with $CuK\alpha$ radiation. The results give, in the case of copper, agreement with Armstrong's measurements, and in the case of silver with the scattering function calculated from the Thomas-Fermi atomic model. H. N. A.

874. X-Ray Scattering Coefficient as a Function of Wave-Length and Atomic Number. E. N. Coade. *Phys. Rev.* 36. *pp.* 1109–1115, *Oct.* 1, 1930.—The mass scattering coefficients for Au, Sn, Ag, Fe and C were compared with those of Al for wave-lengths between $\lambda = 0 \cdot 48$ Å. and $\lambda = 1 \cdot 09$ Å. by collecting the scattered radiation in an ionisation chamber surrounding the scatterer on one side. The primary beam consisted of characteristic fluorescence radiation excited in radiators of Sn, Ag, Mo and Se by a water-cooled tungsten tube. The ratios obtained are shown in the table. With Hewlett's measurement of the absolute value of the mass scattering coefficient of carbon these ratios can be transformed into absolute scattering coefficients. AUTHOR.

875. Atomic Scattering Powers of Nickel, Copper and Iron for Various Wave-Lengths. R. W. G. Wyckoff. *Phys. Rev.* 36. *pp.* 1116–1120, *Oct.* 1, 1930.—Atomic scattering powers are measured for the atoms in metallic nickel, copper and iron when they are reflecting the $K\alpha$ lines of molybdenum, copper, nickel and iron. These data show that the scattering power of an atom passes through a minimum at its K absorption limit and attains a maximum at, or near, its " resonance " wave-length. The atomic F-curves of the nickel atom in metallic nickel and in NiO are practically identical. [See also Abstract 2840 (1930).] AUTHOR.

876. Simple Graphical Method for Estimation of Debye-Scherrer Diagrams. W. Eulitz. *Zeits. f. Physik*, 64. 7–8. *pp.* 452–457, 1930.—A method is explained whereby the estimation of cubic diagrams can be carried out graphically without calculations. The method is illustrated by its application to a rock-salt diagram. J. J. S.

877. Laue Photographs of Iridescent Crystals of Potassium Chlorate. S. C. Sirkar. *Indian Journ. Phys.* 5. *pp.* 337–343, *Sept.* 15, 1930.—The Laue pattern obtained by passing X-rays normal to the 001 face of a single crystal of potassium chlorate is compared with that produced under the same conditions, by the same crystal, heated almost to its melting point and then cooled. It is observed that in the latter case each of a particular group of spots is split up into two and sometimes into three. A coloured crystal of potassium chlorate, as well as a thick twinned crystal, gave Laue patterns exactly identical with that produced by the heated crystal. The indices of the planes giving rise to these spots were determined, and it is shown that these double spots are produced by a twinned crystal, and that the triple spots owe their origin to twinned strata more than two in number, situated inside the crystal not exactly parallel to each other. Laue photographs thus show that on heating a single crystal of potassium chlorate, twinned strata, almost parallel to each other, appear in it, and that these strata are also present in the coloured crystals. The investigation thus lends support to the late (Lord) Rayleigh's theory of the iridescence of these crystals. [See Abstract 1827 (1923).] AUTHOR.

RADIOACTIVITY.

878. Separation of Elements in Minute Amounts. O. Erbacher and K. Philipp. *Zeits. f. phys. Chem.* 150. *Abt. A.* 3–4. *pp.* 214–218, *Oct.*, 1930.—A method is given for obtaining polonium and radium E practically free from their mother substances, radium D and radium E or radium D alone. The adsorption of ions by metals is also discussed. [See Abstract 857 (1929).] J. J. S.

879. Probability Law Governing Disintegration of Radioactive Materials in Very Small Concentration. G. I. Pokrowski. *Zeits. f. Physik*, 65. 1–2. *pp.* 133–138, 1930.—Shows that the variation from the ordinary probability law increases as the concentration of the radioactive material diminishes. Some remarks are made on a paper by Feather [see Abstract 3168 (1930)], who, working with polonium, obtained a negative result. It is noted that the diameter of the field of view was small in Feather's observations, that polonium was used instead of radium, that it had only been prepared a few months before the experiment, and that it had a relatively high concentration, which was only diminished just before the observation. Notes also recent work by Herszfinkiel and Dobrowolska [see Abstract 2853 (1930)]. There is a possibility that the results are affected by psychological or physiological causes. H. N. A.

880. Attempt to Influence the Normal Decay of a Weak Source of Polonium. N. Feather. *Cambridge Phil. Soc., Proc.* 26. *pp.* 538–541, *Oct.*, 1930.—A point counter, and a two-stage amplifier actuated a Weston galvanometer relay, which controlled the grid voltage of a thermionic valve. In the plate circuit of this valve a second relay operated the escapement of a chronograph, which was used to add up the fourteen time intervals between fifteen consecutive impulses. The weak polonium source was irradiated from time to time by the γ-rays from a glass tube containing about twenty equivalent mg. of mesothorium. No definite influence on the mean intervals between the consecutive impulses owing to this irradiation was observed. H. N. A.

881. Artificial Disintegration of Elements. C. Pawlowski. *Comptes Rendus*, 191. *pp.* 658–660, *Oct.* 20, 1930.—By means of a new apparatus the emission of H-particles by carbon, magnesium, aluminium, silicon and sulphur, at an angle of 130° to the incident α-rays (from polonium preparations of intensity equal to that of 0·2—30 mg. of radium), has been demonstrated, with results in close agreement with those of Bothe and Fränz [see Abstract 2421 (1928)], save as regards carbon. None were obtained from iron, zinc, silver or lead. C. A. S.

882. Possible Conception of Radioactivity. M. de Broglie. *Comptes Rendus*, 191. *pp.* 689–690, *Oct.* 27, 1930.—Combining the theory that radioactivity is due to a species of swell among the constituents of the nucleus of the radioactive element, culminating at regular intervals in instability, causing disintegration, with the fact that the mass of the proton in the nucleus is slightly less than that of the free proton (by the packing fraction, which represents loss of free energy on formation of the nucleus), it is pointed out that the packing fraction of a radioactive atom must vary, seeing that the amount of internal energy varies. The mechanism of such variation can only be the alternate emission and absorption of photons resulting in a species of statistical equilibrium of radiation. Thus to explain radioactivity the nucleus must be considered, together with external radiation, and radioactivity must not be regarded as a purely internal process. C. A. S.

883. Activity of Potassium and Rubidium Measured with the Electron Counting Tube. W. Mühlhoff. *Ann. d. Physik*, 7. 2. *pp.* 205–224, *Oct.* 31, 1930.—With the electron counting tube several radioactive constants of potassium and rubidium were determined which hitherto were not known or only insufficiently known. A comparison was made between the potassium γ-radiation and the γ-radiation of thorium C and radium C, and from this the value $\mu = 0\cdot59$ cm.$^{-1}$ was found for the absorption coefficient of the K γ-radiation in lead. Comparison measurements with a radium standard preparation of 0·03 mg. Ra showed that the intensity of the γ-radiation of RaC (in equilibrium with radium) is to that of potassium in the ratio of $3 \times 10^{10} : 1$. Measurements of the β-activities of K and Rb gave for the proportion of the intensities of K : Rb : U the value 1 : 16 : 500, in which for uranium only a β-radiating component (*e.g.*, UXI) is taken into account. J. J. S.

884. Range of the α-Particles from Thorium. G. H. Henderson and J. L. Nickerson. *Phys. Rev.* 36. *pp.* 1344–1347, *Oct.* 15, 1930.—The range of the α-particles from thorium has been found from Wilson expansion chamber photographs to be $2\cdot59 \pm 0\cdot05$ cm. This agrees reasonably well with the Geiger-Nuttall relationship and greatly extends its applicability. AUTHORS.

885. Formation of Long-Lived Active Molecules in Hydrogen Subjected to the Action of α-Particles from Radon. E. C. Truesdale. *J. Phys. Chem.* 34. *pp.* 2472–2478, *Oct.*, 1930.—Repetition of Duane and Wendt's experiments on the activation of hydrogen by α-particles from radon [see Abstract 1316 (1917)] with certain refinements yielded no evidence of the formation of H_2S unless sulphur was present in the reaction sphere surrounding the radon, when it could be detected in small amounts. Moreover, no evidence was obtained of the existence of any long-lived active hydrogen, including that previously referred to as triatomic hydrogen. The rate of recombination of hydrogen ions and electrons at atmospheric pressure is too great to permit detection of their action on sulphur after 0·1 sec., starting with a steady state ion concentration of approximately 1×10^{10} per c.c. T. H. P.

886. Fine Structure of α-Radiation. J. Thibaud. *Comptes Rendus*, 191. *pp.* 656–658, *Oct.* 20, 1930.—The differences in the velocities of α-particles have been attributed to their originating from different levels in the nucleus, whilst displacements from level to level cause emission of γ-rays. It is now shown that the former effect can also be explained on the assumption that the radioactive nucleus possesses spin, in which case the energy differences should be in simple integral ratios to one another. This is shown to be approximately the case, *e.g.*, for ThC, 40·6 : 287 : 421 : 442 = 1 : 7·06 : 10·3 : 10·89. On this theory emission of the α-particle will leave the nucleus in an excited state, return from which is accompanied by emission of a γ-ray. C. A. S.

887. Revised Theory of the Internal Absorption Coefficient of the γ-Rays of RaB, C, C′. R. H. Fowler. *Roy. Soc., Proc.* 129. *pp.* 1–24, *Sept.* 3, 1930.—The γ-rays emitted by radioactive nuclei are often very strongly absorbed in a species of photoelectric effect by the planetary electrons of the parent atom, thus giving rise to the sharp lines of the β-ray spectrum. Notable abnormalities occur in the numerical values found for this " internal conversion coefficient " of the γ-rays from RaBC and RaCC′D. In the present paper a revised theory is developed with the object of explaining these abnormalities by introducing explicitly a speculative nuclear structure and examining what interaction effects can be found between some quantum-mechanical nuclear system and the K- and other electrons of the outer atom. In particular an explanation is reached of the strong abnormally converted β-ray at $14 \cdot 26 \times 10^5$ volts, which it is suggested results from an excited nuclear state from which a radiative transition is impossible. J. J. S.

888. Distribution of Direction of the Recoil Rays Produced by Scattered γ-Rays. D. Skobelzyn. *Zeits. f. Physik*, 65. 11–12. *pp*. 773–798, 1930, *and* 67. 1–2, *p*. 146, 1931.—A description is given of an investigation of the distribution of direction of the Compton recoil electrons by means of the fog chamber method. The method of measurement is described and the results are given of two series of observations, including a total of 1370 measurements of angle. There is a contradiction between the results found and the formula deduced by Dirac and Gordon in 1926. Attention is drawn to the noteworthy quantitative coincidences with the consequences of the new theory of Klein and Nishina. The statistical statement appears, however, to require the existence of specially favoured directions, *i.e.*, of secondary sharply defined maxima and minima of the distribution curve, which before hand was not to be expected. J. J. S.

889. Oscillations and Barometer Effect of Cosmic Radiation at Sea Level. E. Steinke. *Zeits. f. Physik*, 64. 1–2. *pp*. 48–63, 1930.—During the year 1929 twenty series of measurements were undertaken at Königsberg with a total of 3500 registered hours, partly with an apparatus enclosed on all sides with 12 cm. of iron, partly with an arrangement open at the middle. The whole range of the observations indicated that besides numerous radiation oscillations other changes of intensity occur, partly periodic, partly unperiodic, *viz.*, oscillations reflected in the position of the barometer (" barometer effect "), periodic oscillations with the time of year, similar ones with the time of day, irregular changes of intensity over long ranges of time from unknown causes, finally periodic oscillations varying with sidereal time. The barometer effect does not remain constant during the separate series of measurements but shows great oscillations, on the average, however, it is nearly equal to the heights effect. The grounds for the occurrence of the other oscillations are not yet explained. The sidereal time oscillations indicate the cosmic origin of the radiation and the existence of special centres of emission. J. J. S.

890. Structure of Ultra-Radiation. W. S. Pforte. *Zeits. f. Physik*, 65. 1–2. *pp*. 92–101, 1930.—Describes a fully automatic, registering, compensated arrangement, with two ionisation chambers. The ionisation current can be measured to 1 or 2 parts per 1000. The residual current was measured in a salt mine 406 m. deep; it was about 0·03J and very constant. The chambers were irradiated with radium γ-rays in the mine (1J), and a variation of 0·2 % was observed. This seems to prove that the variations of the ultra-radiation are not caused by the residual radiation, nor by the ionisation phenomenon as such. The variations are a characteristic of the ultra-radiation. H. N. A.

HEAT.

891. Values of the Functions $\overline{K}_0$ and $\overline{K}_1$. K. Yosikata. *Tohoku Univ., Technol. Reports,* 9. 3. *pp.* 1–6, 1930. *In English.*—Though the definitions and the use of the functions $\overline{K}_0$ and $\overline{K}_1$ have already been inserted in some books dealing with heat conduction, such as Byerly's work, as far as the author is aware, the tables of the values of these functions have not yet been published. Owing to the recent progress of the mathematical treatment of the technological problems involved, it seems that the necessity for these numerical tables is becoming more urgent day by day and, in consequence, the author in his present paper has calculated the values of $\overline{K}_0$ and $\overline{K}_1$ to some convenient decimal places arranged in tables and graphs. AUTHOR.

892. Heat Loss in a Finite Hollow Cylinder. K. Yosikata. *Tohoku Univ., Technol. Reports,* 9. 3. *pp.* 7–19, 1930. *In English.*—One method of measuring thermal conductivities is that of heating the inside of a hollow cylinder, and measuring the heat flow through a central length, under a known temperature difference. The paper is a mathematical investigation of the error involved in using the formula appropriate to an infinitely long cylinder for reducing these results, instead of the complicated formula which applies more strictly for a finite cylinder. J. H. A.

893. Exchange of Energy between Gas Atoms and Solid Surfaces. J. K. Roberts. *Roy. Soc., Proc.* 129. *pp.* 146–161, *Sept.* 3, 1930. —Experiments were carried out with helium using wires of tungsten and of nickel, the surfaces of which were cleaned and carefully freed from films of adsorbed gas. Measurements were made of the accommodation constant a in the equation giving the relation between Q the heat lost per unit area of the wire per second, p the pressure of the gas, T_2 the temperature of the wire, T_1 that of the surrounding cylinder, μ the molecular weight and T the mean temperature. The effect of roughness of the surface was studied. The values obtained for clean, gas-free surfaces of tungsten were 0·05 to 0·07, and 0·08 for nickel, which are considerably lower than those ordinarily obtained for gas-covered surfaces. To explain the results it seems necessary to consider the phenomenon from the point of view of the reflection and diffraction of molecules, using wave mechanics, and that the molecules of the minute crystals of which the metal is made up are regularly spaced. Calculations made using the classical collision theory do not give results agreeing with the experimental ones. H. N. A.

894. Emission of a Black Body and Temperature. A. Press. *Zeits. f. Physik,* 65. 11–12. *pp.* 734–738, 1930.—Considers the way in which the speed of propagation inside a black body may affect the emission. Introduces the refractive index of the medium into the Stefan-Boltzmann formula. E. E. F. d'A.

895. Photographing of Cooling Curves. H. D. Crockford and A. E. Hughes. *J. Phys. Chem.* 34. *pp.* 2624–2626, *Oct.,* 1930.—Two beams of light fell upon the mirror of a galvanometer in the thermoelectric circuit; one of these was reflected upon a scale and the other (reduced to a fine pencil by means of a system of crossed slits) upon a photographic film mounted upon a drum. The drum could be set in rotation when the temperature of the sample had fallen to a convenient point just above a change-point, and stopped automatically at some lower temperature value. The temperature-scale of the photographic record was determined by galvanometer scale readings at its beginning and end. L. V. C.

896. Small Apparatus for Production of Very Low Temperatures. M. Ruhemann. *Zeits. f. Physik*, 65. 1–2. *pp*. 67–74, 1930.—Description of a simple apparatus which can be made at a small cost in any laboratory workshop and is constructed on the Linde principle. If liquid hydrogen and compressed helium are available it is possible to obtain a temperature as low as the boiling point of helium in about 7 min.; by pressure reduction the temperature may be reduced to 1·9° Abs. It is essentially a machine of small refrigerating capacity suitable for the maintenance of small bodies at very low temperatures, and can be utilised for magnetic measurements or electrical conductivity measurements at such temperatures. W. C. S. P.

897. Micro-Furnace for Temperatures above 1000° C. H. S. Roberts and G. W. Morey. *Rev. Sci. Instruments*, 1. *pp*. 576–580, *Oct*., 1930.—Description of a furnace which consists essentially of a strip of alloy of 60 % platinum and 40 % rhodium 0·01 mm. thick, 8 mm. wide and formed into a **U** about 1·2 mm. wide and 10 mm. deep, which is heated electrically and attains a temperature of 1800° C., near the bottom of the **U** with a current of 30 amp. at 3 volts. The instrument is suitable for measurements of melting points at high temperatures. An optical pyrometer is used to measure the temperature and, for accurate work, must be calibrated in terms of some standard substance of known melting point. W. C. S. P.

898. General Theory, Design and Construction of Sensitive Vacuum Thermopiles. C. H. Cartwright. *Rev. Sci. Instruments*, 1. *pp*. 592–604, *Oct*., 1930.—Part I.—A complete theory and discussion of vacuum thermopile design is given for N junctions in four different types of construction. Practical construction and application of the thermopiles is reviewed. Sensitivity and rapidity of attainment of thermal equilibrium are assessed by consideration of radiation from the receivers and conduction through the wires; other factors, *e.g.* Peltier heat, Joule heat, Thomson heat, being proved theoretically and experimentally negligible. Assuming this, formulæ for each of the four constructions are deduced. The derivation of the optimum conditions in each case is made by assumption of the validity of the Wiedemann-Franz law. Maximum sensitivity depends upon the sensitivities, resistances and characteristics of the galvanometers available and the areas of concentration of the radiation to be measured. In cases where it is impossible to concentrate the incident radiation into as small a receiver as can be made, the number of junctions in series can be calculated from a simple formula. Construction with the junctions in series/parallel gives no increase in the sensitivity. Receivers should be blackened on the front side only and with material black only to the wave-lengths of the light to be measured. Increased sensitivity is obtained by operating the thermocouples at liquid oxygen temperature. Multiple junctions prove advantageous for use with high resistance galvanometers or where concentration of radiant energy into small areas is difficult. The theory given is general, but specially applicable to high thermoelectric power bismuth alloy wires at room temperature, and for a critically damped galvanometer circuit. Thermocouples are described constructed with

various sizes of gold-leaf receivers and wires. Complete agreement between theory and practice is found. Part II.—A description of the construction of a vacuum thermopile with a sensitivity of 1μV for 10^{-8} cal./sec. falling on an area 0·5 sq. mm. on the receiver. Thermal equilibrium is reached in 0·1 sec. Sensitivity *in vacuo* increases from twenty to forty times that in air. Bismuth alloy wires soldered to a gold-leaf receiver blackened on one side by electroplating with Pt black were used. Greater sensitivity for visible radiation was attained, using a receiver of silver leaf tarnished by H_2S, the sensitivity decreasing for wave-lengths longer than 1μ.
S. G. B.

899. Temperature Measurement with the Platinum Thermometer up to 1100° C. H. Moser. *Ann. d. Physik*, 6. 7. *pp.* 852–874, *Oct.* 8, 1930. *From the Reichsanstalt.*—A description, with all practical details of the method of use of a platinum resistance thermometer up to temperatures of 1100° C. A considerably thicker measuring wire is used of 0·5 to 0·6 mm. in diameter. The thermometers described are of simple construction and record the temperature with an accuracy of 0·1° C. at the temperature of the melting point of gold (1063° C.). The following formula is given as expressing the relationship between the electrical resistance R of the platinum with the temperature t between 0° and 1100° C. with considerable validity over the range:

$$t = 100 \cdot \frac{(R_t - R_0)}{(R_{100} - R_0)} + \delta \cdot \frac{t}{100} \cdot \left(\frac{t}{100} - 1\right) + \gamma \cdot \frac{t}{100}\left(\frac{t}{100} - 1\right)\left(\frac{t}{444 \cdot 6} - 1\right)$$

of which the constants R_0, R_{100}, δ and γ are measured and determined at the ice point (0·000° C.), steam point (100·000° C.), sulphur point (444·60° C.) and the gold point (1063° C.) respectively. Details are discussed of the effect of alteration of the sensibility and properties of the platinum wire at the higher temperatures and it is shown that so long as the limits prescribed in the Matthiessen law are not transgressed the above expression is valid.
S. G. B.

900. Expansion of Metals at High Temperatures. F. L. Uffelmann. *Phil. Mag.* 10. *pp.* 633–659, *Oct.*, 1930.—An optical interference method, for measurements in three perpendicular directions on the same specimen, and for use up to 800° C., is described. The use of continuous temperature variation is made possible by a device for equalising the temperature-lag of the platinum resistance thermometer and the specimen. Observations were taken during both heating and cooling of the specimen. Results are given for tin, cadmium, zinc, lead, aluminium, copper, brass, cobalt, nickel and steel, and where possible the quadratic and Thiesen's relations are fitted. Tin, cadmium and zinc show pronounced anisotropic properties; while for cobalt, nickel and steel the coefficient of expansion curve during heating is different from that during cooling, cobalt showing a sharp peak at 450° C. on heating and at 330° C. on cooling.
AUTHOR.

901. Melting Points of Platinum Alloys. L. Müller. *Ann. d. Physik*, 7. 1. *pp.* 9–47, *Oct.* 23, 1930.—A method for the measurement of high temperatures above 1500° C. is described which is specially suitable for the determination of the melting points of those metals and their alloys which melt at a high temperature. In this method the radiation emitted by a hot body within a region of the spectrum limited as much as possible is measured with the help of a photoelectric cell. For standards of reference, substances are used whose emissive capacities are as far as possible similar to that of the substance to be measured. The method was employed for the determination of the solidification points (liquefaction curves) of alloys of platinum with rhodium, iridium, tungsten and chromium. The known solidification points of the pure metals Pd, Pt, Rh and Ir were used as standard reference points. From these liquefaction curves as well as from microscope slides and the values of the electric conductivity and the temperature coefficient of resistance the formation of mixed crystals could be explained. A continuous series of mixed crystals appears to occur in Pt alloys with rhodium from 0 to 100 %, iridium from 0 to 100 %, tungsten from 0 to at least 50 %, chromium from 0 to at least 10 % by weight, but not more than 30 %. J. J. S.

902. Determination of the Melting Point of Chromium with a Thermoelement. L. Müller. *Ann. d. Physik,* 7. 1. *pp.* 48–53, *Oct.* 23, 1930.—The differing results found in previous measurements of the melting point of Cr seem to have been sometimes due to the absorption of carbon when the metal was melted and came into contact with CO gas. This source of error does not occur with the use of a h.f. furnace, and this method, with the use of a thermoelement, was adopted in the research described. The thermoelement consisted of Ir with on the one side 10 % Rh and on the other side 10 % Ru. Electrolytic Cr was used, which was melted in the h.f. furnace in crucibles which were prepared from zircon dioxide, or in Auer's zircon crucibles under hydrogen. The solidification temperature for pure chromium was found to be 1805° C. J. J. S.

903. Relationships between Melting Points, Normal Boiling Points and Critical Temperatures. R. Taft and J. Stareck. *J. Phys. Chem.* 34. *pp.* 2307–2317, *Oct.,* 1930.—Previous work on the ratios between critical temperatures and normal boiling points and the ratios between melting points and boiling points is discussed. Prudhomme's " rule of the three temperatures " is given in the form: critical temperature = melting point + boiling point + 273, using Centigrade temperatures. This rule has been applied to a large number of substances, using the values given in the international critical tables, and it has been found to hold within 2 % for 32 substances and within 3 % for a further five. The ratios T_F/T_C and T_F/T_B are not even approximately constant, but definite relationships between these constants do exist for restricted groups of compounds. In the case of the aliphatic hydrocarbons the limiting value of the ratio T_F/T_B is 0·5. W. C. S. P.

904. Method for Determining Critical Constants and Its Application to Diphenyl ($C_6H_5 . C_6H_5$). J. M. Cork. *Rev. Sci. Instruments,* 1. *pp.* 563–568, *Oct.,* 1930.—A relatively simple method, leading to an evaluation of the critical constants characteristic of a substance as well as the liquid and saturated vapour densities with varying temperatures is described. The method is employed in the case of diphenyl ($C_6H_5 . C_6H_5$) giving values of the critical pressure, temperature and density, of 31,400 mm. Hg, 528° C. and 0·343 gm./cm.^{3} respectively. AUTHOR.

905. New Application of Azeotropism. M. Lecat. *J. Phys. Chem.* 34. *pp.* 2508–2518, *Oct.,* 1930.—Gives a clear definition of azeotropism. In certain cases a binary mixture of liquids boils at a constant temperature t_A during the whole of the distillation. This depends on the proportions between the components, and on the outside pressure; t_A must necessarily be above or below the boiling point of either of the components. Such mixtures are called azeotropes, the azeotropism being called positive when they are more volatile than the components, and negative when they are less volatile; the azeotropic shift δ, is the difference between the boiling point of the azeotrope and the most volatile component in the positive case, and the least volatile component in the negative case. Gives a general statement of the azeotropic method of analysis with examples and directions for carrying out an analysis. Previous papers by the author may be consulted. [See Abstract 3179 (1930).] H. N. A.

906. Determination of the Mercury Content of Air. K. Müller. *Zeits. f. Physik*, 65. 11–12. *pp.* 739–758, 1930.—Measurements with a specially designed photometer, employing a photoelectric cell in conjunction with an electrometer, show that the absorption by mercury vapour at 10^{-3} to 10^{-6} mm. pressure of the resonance line at 2537 Å. follows Beer's law. After calibration of the apparatus with air of known mercury content, according to the method described, the quantity of mercury vapour in a sample of air may be determined within 5 min.. Using a 50-cm. long absorption tube 2×10^{-6} gm./m.^{3} may be detected. The method has the advantage that it may be employed to obtain instantaneous values, whereas chemical methods yield only average values over a period of time. H. F. G.

907. Entropy of Hydrogen. D. MacGillavry. *Phys. Rev.* 36. *pp.* 1398–1404, *Oct.* 15, 1930.—The entropy difference between ordinary hydrogen and hydrogen in perfect equilibrium, both in the solid phase at the absolute zero, has been calculated to be $(3/4)R \log 3 + R \log 4$. This value checks the result given by Giauque and Johnston [see Abstract 1251 (1929)]. The method is the direct evaluation along a reversible path of $\int dQ/T$ under certain idealised assumptions, using partition functions. The thermodynamical and statistical aspects are examined. AUTHOR.

908. Thermodynamic Researches on Supercooled Phases. H. Schmolke. *Zeits. f. Physik*, 64. 9–10. *pp.* 714–716, 1930.—A discussion of Nernst's theorem in relation to the problem of supercooled substances. Although it is not directly applicable in this case, it is not true to say that the theorem then fails. J. H. A.

909. Thermodynamic Action and Reaction. W. Jazyna (Jacyno). *Zeits. f. Physik*, 65. 7–8. *pp.* 571–573, 1930.—In the equation of energy that corresponds to the irreversible process we have the difference between the external and thermodynamic expenditures of heat equal to the thermal energy of friction, which represents the real waste of energy. This wasted energy should be understood as only the thermodynamical part of the energy of convectional, frictional and vortical movements. It determines the thermal irreversibility of the process, and is shown to depend, not immediately on the nature of the bodies, but on the thermodynamic correlation and the difference of temperature. This can be otherwise expressed by the statement that the thermal frictional heats of the working bodies and the source of heat in any process are equal to each other. This equality necessarily proceeds from the independence of the energy equation of the "thermodynamical co-ordinates," *i.e.*, choice of working bodies and source of heat. T. B.

SOUND.

910. Ultrasonic Velocity and Absorption in Oxygen. W. H. Pielemeier. *Phys. Rev.* 36. *pp.* 1005–1006, *Sept.* 1, 1930.—The velocity and absorption in oxygen at room-temperature were measured at five ultrasonic frequencies located in the two octaves, 316 to 1264 kc./sec. The observed velocities reduced to 0° C. do not differ more than 0·2 % from Dulong's observed value of V_0 for audible sound (317·2 m./sec.). The theoretical value ($V_0 = (\gamma p/d)^{1/2}$) is 314·76 m./sec. The observed absorption values vary with frequency as expected but the deviations from the theoretical values are greater than the velocity deviations. AUTHOR.

911. Measurement of Sound Absorption. V. L. Chrisler and W. F. Snyder. *Bureau of Standards, J. of Research,* 5. *pp.* 957–972, *Oct.,* 1930.—This paper contains a brief discussion of the theory of reverberation measurements. The reverberation room is described and details are given as to the method of measuring sound absorption by means of the ear. Methods are also described by which sound absorption can be determined from oscillograph records or by the use of an attenuator box and a valve voltmeter. AUTHORS.

912. Velocity of Sound in Soft and Brittle Substances. E. J. Irons. *Journ. Sci. Instruments.* 7. *pp.* 323–326, *Oct.,* 1930.—The paper describes a modification of Stefan's method for velocity determinations which involves the measurement of the free periods of a fixed-free rod formed by compounding the soft material with a substance in which longitudinal waves may be generated. The requisite formula is derived by the method of "impedance," and values for the velocity of sound in eight common substances are tabulated. AUTHOR.

913. "Artificial Characteristic" of a Spherical Group. F. A. Fischer. *E.N.T.* 7. *pp.* 369–372, *Sept.,* 1930.—In continuation of previous work [see Abstract 2739 (1927)], an investigation is made of the directional effect of a system of point sources arranged on the surface of a sphere. The properties of a "compensated" spherical surface are expressed in terms of linear groups of point sources. G. E. A.

914. Diffraction and Anomalous Propagation of Sound. B. Sandmann. *Gerlands Beitr. z. Geophys.* 28. 1–3. *pp.* 241–278, 1930.—The occurrence of diffraction of sound waves is discussed, and the sound ray is regarded, as in refraction, as the path of transport of energy. The combination of diffraction and refraction cannot be mathematically treated by the classical theory of diffraction. The conditions are discussed which give rise to diffraction in the atmosphere. The meteorological conditions under which diffraction in conjunction with a zone of silence at a short distance from the source of sound has been observed, are identical with those of the vertical structure of the atmosphere (troposphere and stratosphere), conditions which are favourable to the occurrence of diffraction. G. E. A.

915. End-Corrections of an Open Organ Flue-Pipe, and the Acoustical Conductance of Orifices. A. E. Bate. *Phil. Mag.* 10. *pp.* 617–632, *Oct.,* 1930.—The end-correction α for the "mouth" of the pipe is $a = A\sqrt{\pi}/2k\sqrt{\omega}$, where A is the sectional area of the pipe, ω the area of the mouth, and k a constant depending on the shape and size of the mouth. The correction β for the open end of the pipe is 0·66R, where R is the radius of the section of the pipe. The conductance C of a circular orifice of diameter d in the otherwise closed end of a cylindrical resonator of diameter D is $C = 2^{d/D}d$. This formula may be applied to square orifices, if d is the diameter of a circle equal in area to the square. For a narrow rectangular orifice, the conductance may be treated as that of an ellipse of equal area. [See also Abstracts 1537 and 2247 (1930).]

G. E. A.

916. Electrical Organ. E. Coupleux and Givelet. *Comptes Rendus,* 191. *pp.* 557–560, *Oct.* 6, 1930.—Of the two methods by means of which a triode, with suitable LC circuit, may be employed to transform electrical oscillations into sound vibrations, that of interference is unstable, and the direct method is chosen. The notes produced would be tuned on a scale of equal temperament involving the production of beats; but this difficulty may be overcome by using a simple sine wave in conjunction with an electric filter with low impedance for musical frequencies and high impedance for very low beating frequencies. Different groups of harmonics may then be superposed on the fundamental, by a special use of the valve, in order to obtain the qualities of the 'cello, oboe, flute, etc. Also, musical effects may be imitated, *e.g.*, the tremolo, by placing in the grid circuit of one of the amplifying valves a condenser shunted by a high resistance. By combinations of circuits, a double-manual organ with a range of 108 notes may be constructed from fifteen valves. The advantages of such an organ are: reduction in size, since the pipes and blowing apparatus are not required; a total absence of inertia, enabling the performance of rapid passages and instantaneous change from fortissimo to pianissimo; the possibility of transmitting the sound to all parts of a building; and the possibility of obtaining tones of new quality, and of great purity, and of imitating the human singing voice. G. E. A.

917. Rendering Short Sound Waves Visible. H. Kröncke. *Phys. Zeits.* 31. *pp.* 908–909, *Oct.* 15, 1930.—Arrangements are described for rendering visible the positions of the nodes and antinodes of short sound waves in a Kundt's tube. In place of the usual powder is used a wire running the whole length of the tube and electrically heated just to incandescence. At the points where there is the most violent agitation of the air, due to sound waves in the tube, the wire is cooled and the glow disappears, so that the nodes are shown by bright points along the wire with dark portions between. A wire of chrome-nickel 0·08 to 0·10 mm. diameter was found to give the desired effect better than other wires used.

A. W.

918. Perception of the Direction of Sound. M. Ishimoto and K. Kurihara. *Imp. Acad. Tokyo, Proc.* 6. *pp.* 310–312, *Oct.,* 1930. *In French.*—Two series of experiments are described, *viz.*, with musical sounds produced by a loud-speaker included in an oscillating circuit containing a triode valve, and sounds produced by the interruption of a non-oscillating circuit by means of a seconds pendulum. The following conclusions are drawn: (1) For sounds of frequencies above 1200 the perception is obscured. (2) The perception curve is larger for musical sounds than for the others. (3) For musical sounds, perception depends on frequency.

H. H. Ho.

ELECTRICITY AND MAGNETISM.

ELECTROSTATICS, TERRESTRIAL ELECTRICITY AND MAGNETISM.

919. Comparison of Two Methods for Determining the Contact Potentials Between Metals. G. Mönch. *Zeits. f. Physik,* **65.** 3–4. *pp.* 233–243, 1930.—Determination of the contact potentials between metals by the measurement of the emission current of a heated filament when each of the metals in turn is employed as the anode yields results which are in good agreement with those obtained by the Thomson method. Under the influence of the electron stream the anode tends to become more electronegative and, since the effect occurs with various metals, it is probably caused by degassing of the anode. Critical comparison of the two methods shows the electronic method to be preferable, as it yields practically a point value of the potential, as compared with the relatively large area involved in the Thomson method, and tends to purify rather than to contaminate the surface of the metal. H. F. G.

920. Potential and Potential Energy of Space Lattices. C. N. Wall. *Phys. Rev.* 36. *pp.* 1243–1250, *Oct.* 1, 1930.—The electrostatic potential of a general space lattice is developed. The space lattice is characterised by a base cell containing a finite set of positive point charges arbitrary on strength and position, and a negative space charge of arbitrary density, subject to the condition that the total charge in the cell is zero. Next, the expression for the lattice energy is obtained in the form of a triply infinite series. It is shown that the coefficients in this series representing the distribution of the negative space charge can be identified with the structure factors of the lattice or crystal, provided we replace the negative space charge by a corresponding electron distribution. An application of this theory is made to the three halides NaCl, NaF and LiF. The lattice energy of each crystal is calculated for different grating spaces. In all three cases it is shown that the lattice energy has a minimum in the neighbourhood of the accepted grating space for the crystal under consideration. The agreement is better for NaCl than for NaF or LiF.
AUTHOR.

921. Piezoelectric Phenomena. A. Hettich. *Zeits. f. Physik,* **65.** 7–8. *pp.* 506–511, 1930.—A description is given of a simplified arrangement of the method of Giebe and Scheibe [see Abstract 2594 (1925)] for the observation of piezoelectric excitation. This method can be used in combination with temperature variation for the investigation of modification transitions in suitable cases. It was found that pentaerythrite does not lose its piezoelectricity on being heated to the highest applicable temperatures. Potassium iodate is piezoelectric and its crystals can therefore not be monoclinic prisms. There are indications of a transformation between 140° and 150° C. Carbon tetrachloride is probably not piezoelectric at −80°. Camphor appears to pass over into another modification at low temperatures. J. J. S.

922. Piezoelectric Oscillators. M. Boella. *Elettrotecnica,* **17.** *pp.* 672–678, *Oct.* 15, 1930.—Gives resonance curves obtained by Pierce's two methods from a quartz piezoelectric oscillator and studies the effect of the decrement of the quartz upon the rate of oscillation. E. E. F. d'A.

923. Resonance Curves of Piezoelectric Resonators. G. Angrisano. *Elettrotechnica*, 17. *pp.* 678–679, *Oct.* 15, 1930.—Describes a particularly stable circuit for quartz resonators. It contains two A442 valves and two B405 Philips valves, and three condensers, one of fixed capacity and two of variable capacity, of which one is of 1·5 mf. with a head of 2500 divisions. This allows a fine adjustment within 1/5000 of the capacity. The amplifier is symmetrical and is coupled inductively to the oscillator. E. E. F. d'A.

924. What is an Insulator? A. Meissner. *Zeits. f. Physik*, 65. 3–4. pp. 158–166, 1930.—Attention is drawn to the similarity between the structure of quartz [see Abstract 726 (1931)] and that characteristic in general of insulating materials the cells of which consist of positive and negative ions close together and with a strong bond between them. A second characteristic of insulating materials is the existence of polar axes. An explanation is given of the way in which the polarity of an insulating material may arise and also its build from positive and negative ions. The effect of space charges, and of charges on the electrodes, on the piezoelectric moment is discussed for solid and for fluid insulating materials. A. W.

925. Dielectric Constant of Helium. J. V. Atanasoff. *Phys. Rev.* 36. *pp.* 1232–1242, *Oct.* 1, 1930.—The author develops an extension to the Ritz method as used by Hylleraas [see Abstract 2936 (1929)] for the study of unperturbed helium in its normal state under the influence of an electric field. As in the usual perturbation theory, the characteristic energy parameter E and the characteristic function ψ are assumed developable in power series in the field strength F, but now the coefficients in these equations are given in terms of problems in the calculus of variations. The work of Hylleraas furnishes a knowledge of the terms in both expansions independent of the field strength. Then the minimisation of a single integral furnishes values of ψ_1 and E_2, the subscript of each denoting the power of F for which it forms the coefficient. Values of these coefficients are calculated to three approximations by the direct method, and the dielectric constant is found to be $\epsilon = 1\cdot0000665$. H. H. Ho.

926. Dielectric Constant of Bromine Vapour. A. Bramley. *Frank. Inst., J.* 209. *pp.* 421–423, *Oct.*, 1930.—It is found that the dielectric constant of bromine increases with the temperature but decreases with pressure, indicating that the electric moment of the molecules is greater at the higher temperatures which correspond to higher energy states. Since the dielectric constant decreases with increasing pressure, the molecules, which are raised to the higher energy levels by the absorption of radiation, must lose this energy on collision with other molecules and revert to the normal state. The radiation which the molecules absorb may be either the black body radiation corresponding to the temperature of the gas or it may be higher frequency radiation emitted by the glowing heating coils in the furnace enclosing the condenser. H. H. Ho.

927. Dielectric Constant of Gaseous Hydrogen Cyanide and its Dipole Moment. K. Fredenhagen and F. Maske. *Zeits. f. phys. Chem.* 10. *Abt. B.* 2. *pp.* 142–148, *Oct.*, 1930.—The dielectric constant of

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superheated HCN vapour was measured within the temperature interval of 30° to 200° C. Between 95° and 200° C. the molecular polarisation can be calculated from the Debye formula. The dipole moment is found to be $2 \cdot 1 \times 10^{-18}$ e.s.u. H. H. Ho.

928. Dielectric Constants of Liquid Mixtures and the Degree of Association of their Components. S. Kyropulos. *Zeits. f. wiss. Phot.* 29. 1–12. *pp.* 107–176, 1930.—The results of this investigation show that the fundamental assumption of the applicability of the rule of mixtures is in no case completely fulfilled. In all cases the components change with the mixing process. Admixture of polar acetone with non-polar benzene, which is attended without noticeable volume contraction, nevertheless dissociates the acetone complex. In two other cases—methyl alcohol and water, acetone and water—hydration has to be taken into account. The data for 23 substances are discussed in the paper from the standpoint of their dielectric constants. H. H. Ho.

929. Beat Method for Determining Dielectric Constants of Conducting Liquids. W. Graffunder and R. Weber. *Zeits. f. Physik*, 65. 11–12. *pp.* 723–725, 1930.—The superposition method for measuring dielectric constants used by Herweg is confined to those substances which produce no damping of the oscillation circuit by conductivity or dielectric losses. To extend the method to conducting liquids the authors superimpose another oscillation, which they derive from the mains. A resistance is employed which can be varied within wide limits without altering its capacity. It consists of two valves mounted in parallel, but in opposite directions. E. E. F. d'A.

930. Demonstration of Electric Lines of Force and a New Method of Measuring the Electric Moment of Tourmaline. (Miss) M. E. Maurice. *Cambridge Phil. Soc., Proc.* 26. *pp.* 491–495, *Oct.*, 1930.—When moist air comes into contact with a tourmaline crystal which has previously been cooled to liquid air temperature, ice filaments are formed which follow the lines of electric force due to the charge produced by the pyroelectric effect of the crystal. By allowing a tourmaline heated to 140° C., and then discharged by passing through a flame, to cool in a smoke of NH_4Cl, similar filaments following the lines of electric force are obtainable, some of the filaments being 1 cm. in length. A tourmaline crystal charged by cooling and held over a water surface causes drops of water to be periodically disrupted, and knowing the instability potential for a water surface it is estimated that the electric potential near the end of the tourmaline greatly exceeds 4000 volts. A new method for determining quantitatively the electric moment of tourmaline is described leading to a value for the surface charge (due to pyroelectric effect) of $0 \cdot 5$ e.s.u. per cm.^{2} per °C. W. S. S.

931. Dipole Moments of the o-Dihalogenobenzenes. Part II. E. Bergmann, L. Engel and S. Sándor. *Zeits. f. phys. Chem.* 10. *Abt. B.* 2. *pp.* 106–120, *Oct.*, 1930.—This investigation continues that of Part I [see Abstract 3338 (1930)], which dealt with the importance of dipole measurements for the stereochemistry of carbon, and includes data for the dipole moments of the ten possible o-dihalogenobenzenes and the four monohalogenobenzenes. The results are in good agreement with the authors' previous proposals and also with the considerations of Smallwood and Herzfeld [*Am. Chem. Soc., J.* 52. p. 1919, 1930]. By means of dipole measurements and X-ray data (by Debye) it has been established that molecular distortion occurs with very simple molecules, *e.g.*, asym-dichloroethylene, chloroform and methylene chloride. H. H. Ho.

932. Dielectric Polarisation of Liquid Mixtures. L. M. Das and S. C. Roy. *Indian Journ. Phys.* 5. *pp.* 441–462, *Oct.* 1, 1930.—The dielectric constants of solutions of chlorobenzene and bromobenzene in carbon tetrachloride have been accurately measured by the heterodyne method and their densities determined by a special form of density bottle. The molecular polarisation has been calculated and curves drawn for partial polarisation and concentration of the polar liquids. The zero concentration intercepts gave values which satisfy the Debye formula, $P = A + B/T$. The moments of these liquids were calculated and it was observed that association increases with concentration and temperature. H. H. Ho.

933. Dielectric Polarisation of Some Pure Organic Compounds in the Dissolved, Liquid and Solid States. S. O. Morgan and H. H. Lowry. *J. Phys. Chem.* 34. *pp.* 2385–2432, *Oct.*, 1930.—The dielectric constants, densities and refractive indices of CH_3Cl, CH_2Cl_2, CH_3Br and CH_3I have been determined in dilute solutions of either hexane or carbon tetrachloride or both. The values of the moment calculated from these data are found to agree reasonably well with the values determined by others for these substances in the gaseous state. The dielectric constants and densities of CH_3Cl, CH_2Cl_2, $CHCl_3$, CCl_4, CH_3Br, CH_3I, C_2H_5Br, *p* . $C_6H_4Cl_2$, C_6H_6 and C_6H_{14} have been determined in the pure state for the liquid and solid, and the components of the polarisation for these substances have been calculated. A discussion is given of the use of several new condensers for direct capacity measurements. A simple temperature-dielectric constant equation is shown to exist and an almost linear temperature-density relationship for the methyl halides. The conductance and power factor of CH_2Cl and CH_2Cl_2 are given as a function of temperature and frequency. H. H. Ho.

934. Soundings of High Ionised Layers by Short Waves at Sunrise between Paris and the Sahara. J. Lugeon. *Comptes Rendus*, 191. *pp.* 676–678, *Oct.* 20, 1930. *Arch. des Sciences*, 12. *pp.* 319–339, *Sept.-Oct.*, 1930.—Observations made at El Goléa on intermittent short waves transmitted from Paris on five days indicated the presence of ionised layers at 280, 185, 85 and 50 km. when the Heaviside-Kennelly layer was at a height of 83·6 km. at Zurich and 110 km. at El Goléa. All these layers do not reflect simultaneously. At night the Hertzian waves are reflected by the highest layer, but during the day mainly by the lowest layer. At passage from darkness to light the waves rebound successively from each layer while descending. The layers undergo a vertical movement during the 24 hours, the amplitude being proportional to their respective heights and with a phase difference depending on the speed of the earth's shadow. [See also Abstract 578 (1931).] R. S. R.

CURRENT ELECTRICITY, MAGNETISM AND ELECTRO-MAGNETISM.

935. Electrical Conductivities of Dilute Sodium Amalgams at Various Temperatures. W. J. Davies and E. J. Evans. *Phil. Mag.* 10. *pp.* 569–599, *Oct.*, 1930.—Measurements were made by the method previously described [see Abstract 1309 (1929)], modified as necessary for an alkali metal amalgam, of the resistivities of 11 amalgams containing from 0·307 to 5·27 % (atomic) of sodium at temperatures 0°, 20°, 78·4°, 100° and 185° C, and a few also at 225·8°, 255·2° and 302·2° C. The results are given in tables and curves. Resistivity at constant temperature compared with that of pure mercury increases to about 2 % (atomic) of sodium, is then fairly constant to nearly 4 %, and thereafter declines. Absolute conductivity shows approximately inverse variations, but with somewhat more marked discontinuities near the minimum. The temperature coefficient of resistivity is as a rule greater than that of mercury, and increases with the temperature range, and generally with concentration of sodium. The results are discussed in relation to Skaupy's theory [see Abstract 740 (1921)]. The discontinuities observed may indicate the existence of definite compounds of sodium and mercury in solution in mercury. C. A. S.

936. Electrical Conductivity of Boron-Sodium Glasses. S. A. Schtschukarew and R. L. Müller. *Zeits. f. phys. Chem.* 150. *Abt. A.* 5–6. *pp.* 439–475, *Oct.*, 1930.—The glasses made from the oxides of boron and sodium were chosen for study because they are reasonably low-melting, and can easily be made from the pure materials. Four different methods of resistance measurement were used and the results, on 13 samples covering the range from 0·04 to 33·8 % Na_2O by weight are given for a series of temperatures from 130 to 300° C. Precautions were taken to avoid errors due to surface conduction, and those due to any polarisation or back e.m.f's. For each composition the logarithm of the conductivity is a linear function of the reciprocal of the absolute temperature. The results are discussed in considerable detail, as regards their bearing on the problem of non-aqueous solutions. J. H. A.

937. Change in Electrical Conductivity of Platinum on "Degassing" in High Vacuum and Subsequent Charging with Hydrogen. Klara Weil. *Zeits. f. Physik*, 64. 3–4. *pp.* 237–247, 1930.—Previous work on these lines has yielded discordant results owing to the small amount of hydrogen absorbed by platinum and to the consequent errors caused by gas given off from the walls of the apparatus. The author overcomes these difficulties by use of Schirmann's method of ionic bombardment induced by externally applied h.f. alternating fields [see Abstract 525 (1927)] and measures the resistance of a Pt ribbon (13 cm. × 1 mm. × 0·01 mm.) to ± 0·2 %, using a d.c. bridge method. The platinum is activated by repeated glowing at a dull-red heat *in vacuo* and is then exposed to an atmosphere of hydrogen at 250 mm. Hg pressure. The resistance fell some 3·5 % on activation (by gas removal) and rose again by 1 % on charging with hydrogen [see Kleine, Abstract 2353 (1925)]. The latter change proved, on successive cycles of activation and exposure to hydrogen, to be roughly reversible, thus rendering unlikely the formation of any platinum-hydrogen compound. L. V. C.

938. Electrical Conductivity of Steel and Nickel at High Gas Pressures. T. Skutta. *Zeits. f. Physik*, 65. 5–6. *pp.* 385–403, 1930.—Describes the apparatus employed, in which metal tubes were tested, with the interior filled with hydrogen or nitrogen, under pressures between 1 and 30 atmospheres. At each pressure employed the tubes were strongly heated (glowed) electrically for short periods, cooled off, and the resistance determined. A preliminary treatment of this nature with hydrogen was found to activate the metal, and it then behaved differently when nitrogen at normal pressure was introduced into the tube. The above treatment of steel with hydrogen appears to produce a stable solution of hydrogen in the steel, which causes a rise in the resistance of the material. This resistance is increased considerably when nitrogen is introduced into the activated tube. Nickel appears to give an unstable solution of hydrogen, and becomes activated. The resistance diminishes considerably during the treatment. When nitrogen is introduced into activated nickel tubes it is absorbed, the result being that the resistance rises. H. N. A.

939. Change of Resistance of Very Pure Electrolytic Iron in Longitudinal Magnetic Fields. O. Stierstadt. *Zeits. f. Physik*, 65. 9–10. *pp*. 575–588, 1930.—The iron investigated contained $99\cdot998 \pm 0\cdot001$ % of the pure element, all gases and in particular hydrogen were removed by repeated melting in a high vacuum. The change of resistance in longitudinal magnetic fields may be 100 % greater than in the case of ordinary iron, and the effect of the previous heat treatment is very marked. The change in resistance runs to a certain extent parallel with the magnetisation. With high fields, in the neighbourhood of magnetic saturation, the curves of relative change of resistance become more and more nearly straight lines. It appears possible from the measurements that the *new* Frank-Sommerfeld formula for the theory of the change of resistance in a magnetic field, which was originally developed for substances with permeability about unity, holds also for ferromagnetic substances in the region of saturation. Measurements in high fields are suited for clearing up this question. H. N. A.

940. Anisotropy of the Electrical Resistance of Mercury Crystals. O. Sckell. *Ann. d. Physik*, 6. 8. *pp*. 932–956, *Oct*. 10, 1930.—Mercury crystals at $-78\cdot5°$ C. were prepared in a special glass tube in which the actual resistance measurements were made. It was found that the values of the ratio of the resistance at this temperature to the resistance at 0° C. equalled $0\cdot1527$ measured parallel to the crystal axis, and $0\cdot2034$ measured perpendicular to the axis. Measurements at other temperatures in the range $-45\cdot5°$ to $-191\cdot5°$ C. are also reported. For the ratio of the resistance of fluid mercury to that of solid mercury at the melting point, the values $4\cdot94$ (parallel to axis), $3\cdot74$ (perpendicular to axis) were obtained. The paper includes a detailed comparison of the author's and previous researches on the resistance of solid mercury. W. S. S.

941. Cuprous Oxide Rectifiers. O. v. Auwers and H. Kerschbaum. *Ann. d. Physik*, 7. 2. *pp*. 129–175, *Oct*. 31, 1930.—Studies the phenomena presented by a cuprous oxide layer in contact with copper theoretically and practically from the point of view of photoelectric phenomena in crystals. They may be explained by the transfer of electrons from the copper to the curprous oxide under the influence of light, and by the influence of the e.m.f. upon the resistance of the limiting layer (stopping layer, "*Sperrschicht*"). E. E. F. d'A.

942. Electrical Properties of Cuprous Oxide. W. Vogt. *Ann. d. Physik*, 7. 2. *pp*. 183–204, *Oct*. 31, 1930.—Determines the electrical conductivity, Hall constant, and thermoelectric force of the same preparation of cuprous oxide in the region between $-70°$ and $70°$. The conductivity of one specimen was 420×10^{-7} ohm-cm. at 75°, 224 at 25°, and 7·1 at − 50°. The Hall constant was 40×10^4 cm.^{3}/amp. sec. at 75°, 225 at 25°, and 13,200 at − 50° in the same specimen. E. E. F. d'A.

943. Structure of Long Electric Sparks. T. Kobayasi. *Phys. Math. Soc., Japan, Proc.* 12. *pp.* 240–246, *Oct.,* 1930. *In English.*—A description is given, with photographs, of an experimental study of the structure of long zigzag sparks and the effects produced on the air along their tracks by such sparks. A. W.

944. Mechanism of Spark Discharges. J. Slepian. *Frank. Inst., J.* 209. *pp.* 473–475, *Oct.,* 1930.—It is suggested that the criticism of the author's theory of the spark discharge put forward by Loeb [see Abstract 4082 (1930)] while theoretically sound is at present of no importance in practice owing to the extreme inaccuracy of the values of the ionisation constant *a*. The errors introduced by the values of *a* are many times larger than those associated with the correction of Loeb. F. J. W.

945. High-Frequency Discharge. Part II. CH_4, CH_3Cl, CH_2Cl_2, $CHCl_3$, CCl_4. P. N. Ghosh and B. D. Chatterjee. *Zeits. f. Physik,* 65. 1–2. *pp.* 102–106, 1930.—Studies the striæ produced in discharge tubes containing CH_4 and the other vapours. In CCl_4 they are distinct from a pressure of 0·3 mm. down to 0·035 mm., while in the lighter gases dealt with in Part I [see Abstract 3809 (1930)] they begin to appear at about 1·6 mm. and disappear at about 0·5 mm. The striation of these heavy vapours is observed at higher frequencies than in the case of the lighter gases. This behaviour of the heavy molecules is to be expected in view of J. J. Thomson's theory that the striations are due to non-ionising collisions and their absorption of energy. There is little or no striation when the energy is absorbed at comparatively high potential, so that the molecules are ionised. It can be assumed that with good striation the molecule is normally excited. H. N. A.

946. Current, Pressure and Frequency Relationships for the Initiation and Maintenance of the Electrodeless Glow Discharge. M. L. Braun. *Phys. Rev.* 36. *pp.* 1195–1203, *Oct.* 1, 1930.—Critical current and critical pressure values for the initiation of a discharge and their relation to the excitation frequency have been investigated by means of the electrodeless glow discharge for hydrogen, oxygen, carbon dioxide and nitrogen. A departure from the usual definition of the critical point has been made in choosing as the criterion for its location the approximate centre of the bend on the graph showing the relation between the current necessary to start the discharge and the pressure. By this method it was found: (1) that the critical current varies as the square of the wave-length; (2) that the critical pressure varies as the square of the wave-length; and (3) that the ratio of the critical current to the critical pressure is constant for a given gas. The current necessary to maintain the glow was also investigated, and formulæ obtained expressing relationships between maintaining current, initiating current wave-length and pressure. AUTHOR.

947. Time Changes of Current and Potential Difference at the Formation of the Glow Discharge. F. Tank and L. Ackermann. *Helv. Phys. Acta,* 3. 7. *pp.* 468–476, 1930. *In German.*—A study has been made of the relation between the preliminary ionisation and the

changes occurring with time in the values of current and potential difference at the onset of the glow discharge [see also Abstract 2259 (1929)].
F. J. W.

948. Behaviour of SiO_2 under the Influence of Slow Kathode Rays. H. Peters and T. Schultes. *Zeits. f. Elektrochem.* 36. *pp.* 837–839, *Oct.*, 1930.—It is shown that the reddish fluorescence obtained on glass under the action of slow kathode rays is identical with the reddish light obtained in a discharge tube under the action of a h.f. source (about 50 megacycles/sec.). The spectral distribution of the reddish light obtained with the h,f. discharge was examined and found to correspond with that for the reddish fluorescence on glass subjected to slow kathode rays. The effect is traced to the SiO_2 group.
A. W.

949. Absorption of Slow Hydrogen Positive Rays in Hydrogen. R. E. Holzer. *Phys. Rev.* 36. *pp.* 1204–1211, *Oct.* 1, 1930.—An experimental method for studying the absorption of slow hydrogen positive rays in hydrogen is described. The absorption coefficients of H^+, H_2^+ and H_3^+ in hydrogen were measured in the region between 60 and 850 volts. The absorption coefficient of H^+_3 was found to be smaller than that of H_2^+ and very much nearer the absorption coefficient of H^+ in magnitude. The absorption coefficient of H_2^+ decreased from a value of 40 cm.^{2}/cm.^{3} at 60 volts velocity to 20 cm.^{2}/cm.^{3} at 850 volts and that of H_3^+ decreased from 17 cm.^{2}/cm.^{3} at 60 volts to 12 cm.^{2}/cm.^{3} at 500 volts. The absorption coefficient of H^+ remained nearly constant at 8 cm.^{2}/cm.^{3}, about one-half the kinetic theory value. No minimum of absorption was observed for any of the ions in the region investigated. Qualitative experiments upon the nature of the absorbing process indicate that the absorption of H_2^+ is probably due to neutralisation while scattering is probably the most important factor in the absorption of H^+ and H_3^+ ions.
AUTHOR.

950. Loss of Charge of a Beam of Positive Hydrogen Ions on Passing through Gases and Solids. H. Bartels. *Ann. d. Physik*, 6. 8. *pp.* 957–984, *Oct.* 10, 1930.—The mean free path of a positive hydrogen ion is defined as the average distance travelled between encounters in which an exchange of charges takes place. This mean free path is shown to be inversely proportional to the pressure, and increases approximately linearly with the kinetic energy of the ions. Further, the mean free path is greater in hydrogen than in oxygen and greater in oxygen than in nitrogen. The ratio of the number of positive hydrogen ions to neutral atoms in a beam after passage through a solid is constant if the thickness is greater than 13 $\mu\mu$.
F. J. W.

951. Velocities of H^+ Ions Formed in Hydrogen by Dissociation following Electron Impact. W. W. Lozier. *Phys. Rev.* 36. *pp.* 1285–1292, *Oct.* 15, 1930.—An apparatus is described which is suitable for a study of the velocity distribution of ions formed by single electron impact. Electrons, confined to a narrow beam by a magnetic field, pass along the axis of two coaxial cylinders, ionise the gas and are collected by a trap. The thick, inner cylinder, which is slotted, serves to allow only ions moving perpendicularly to the electron beam to pass to the outer collecting cylinder. A retarding voltage is applied between the cylinders. A study of the positive ion current collected as a function of the retarding voltage permits a determination of the velocity distribution of the ions. The above method is employed in a study of hydrogen.

Theory shows that when the H_2 molecule is ionised by electron impact, it may prove unstable and dissociate into $H^+ + H$ (or H') or into $H^+ + H^+$ if two electrons have been removed. The H^+ ions thus formed possess kinetic energy. The H^+ ions coming from dissociation into $H^+ + H$ should occur at minimum electron velocities of about 27 to 40 volts, possessing roughly 5 to 11 volts velocity; while the H^+ ions resulting from removal of two electrons occur at minimum electron velocities of 46 to 56 volts, possessing 7·5 to 12·5 volts velocity. In agreement with the predictions of the theory it was found that the velocities of those ions resulting from dissociation into $H^+ + H$ and $H^+ + H^+$ together with the minimum velocities necessary to produce them satisfy linear relationships. AUTHOR.

952. Ionisation of Inert Gases by Slow Alkali Ions. O. Beeck. *Ann. d. Physik*, 6. 8. *pp*. 1001–1024, *Oct.* 10, 1930.—The ionisation of the three inert gases A, Ne and He by the alkali ions Li^+, Na^+, K^+, Rb^+ and Cs^+, and for small ionic velocities up to 500 volts, was investigated by an improved method. Such low gas pressures could be used that an alkali ion on the average could come into collision only once with a gas atom in the ionisation chamber. It was found that the ionisation is in general measurable between velocities of the ions of 100 and 300 volts and shows up to 500 volts throughout a rise more or less steep. In He the yield is very small, in part not measurable. For K^+ in A a noteworthy sharper setting-in of the ionisation was established with an ionic velocity of 95 volts. The yield of the ionisation is mostly considerably smaller than that with electron collision. For Na^+ in Ne and K^+ in A however it reaches higher values and for greater ionic velocities still rises and seems to attain at least the maximum yield by electron collision and perhaps to exceed it. An inert gas atom is most easily ionised by the alkali ion which has the same number of electrons in the outer shell as the inert gas atom, thus Ne by Na^+ and A by K^+. J. J. S.

953. Velocity Distribution of Secondary Electrons from Molybdenum. T. Soller. *Phys. Rev.* 36. *pp*. 1212–1220, *Oct.* 1, 1930.—The velocity distribution curves of secondary electrons from a molybdenum target for primary electron velocities from 7·5 to 100 volts are obtained by an improved apparatus, using the magnetic deflection method. Distribution curves quite similar to those observed by others for different metals are obtained, showing a broad low-velocity maximum of secondary electrons and a sharp "reflected" peak whose measured velocity in all cases turned out to be approximately 2 volts less than the corresponding accelerating voltage. It is shown that this should be so, from a consideration of contact potentials. The effect of gas content of the surface on the velocity distribution was investigated. Heating at a temperature of approximately 850° C. for 20 hours produced only slight changes in the curves. A prolonged heating of 41 hours at approximately 1250° C. caused a marked decrease in the low-velocity maximum and an increase in the height of the "reflected" peaks. Both changes are ascribed to the removal of gas from the surface. The curve giving the height of the "reflected" peaks as a function of the velocity of the primary electrons has several maxima. There is a fair correlation between the voltages to which these maxima correspond and the "critical potentials" of Mo observed by Petry [see Abstract 154 (1926)]. AUTHOR.

954. Ionisation of Helium, Neon and Argon by Electron Impact. P. T. Smith. *Phys. Rev.* 36. *pp.* 1293–1302, *Oct.* 15, 1930.—Quantitative measurements have been made of the total number of positive charges produced per electron per cm. path at a definite pressure, in helium, neon and argon, as a function of the energy of the impacting electrons out to 4500 volts. In helium the maximum efficiency 1·256 occurs at 110 volts, in neon 3·008 at 170 volts, and in argon 13·01 at 88 volts. An empirical relation has been found which expresses the efficiency of ionisation of helium within the experimental error for energies greater than 60 volts. The data obtained differ considerably from those found by previous investigations, but because of the more precise length of path from which the positive ions were measured and the more accurate knowledge of the energy of the electrons as well as the elimination of secondary electrons, it is believed that the results presented here are the most accurate thus far obtained. AUTHOR.

955. Ionisation Potentials and Probabilities for the Formation of Multiply Charged Ions in Helium, Neon and Argon. W. Bleakney. *Phys. Rev.* 36. *pp.* 1303–1308, *Oct.* 15, 1930.—The multiply charged ions in helium, neon and argon have been studied with a mass spectrograph previously described. In helium the He+ ion showed up strongly but only faint evidence for the formation of He++ was found and no quantitative data for its relative intensity could be obtained. Neon yielded the three ions Ne+, Ne^{2}+ and Ne^{3}+ as the result of single electron impacts occurring respectively at minimum electron energies of 21·5, 63 and 125 volts. Curves which illustrate the efficiency for the formation of these ions expressed in number of ions per electron per cm. per mm. pressure at 0° C. as a function of the electron velocity exhibit maxima for Ne+ and Ne^{2}+ of 2·75 and 0·16 at 150 and 250 volts respectively. In argon the five ions A+, A^{2}+, A^{3}+, A^{4}+ and A^{5}+ were observed. The ionisation potentials for the first four were found to be respectively, 15·7, 44, 88 and 258 volts for single impact. The efficiency curves show maxima of 11·4, 1·1 and 0·04 at 50, 115 and 250 volts for A+, A^{2}+ and A^{3}+ respectively. In the curves for Ne^{3}+ and A^{4}+ are found several upward breaks beyond their ionisation potentials which indicate other higher critical potentials for their formation. AUTHOR.

956. Optical Excitation Function of Helium. W. C. Michels. *Phys. Rev.* 36. *pp.* 1362–1374, *Oct.* 15, 1930.—With a discharge tube which has been considerably modified from the designs previously used, and with a technique specially developed to eliminate the effects of collisions of the second kind and ionisation and recombination, the author has completed a study of the excitation function of helium for electrons with energies between the excitation potentials and 100 V. Two new features are introduced, namely, experimental conditions under which a linear dependence of intensity on either current or pressure is obtained, and an actual determination of the electron velocity distribution curve. The intensity curves, by themselves, agree fairly well with those obtained by earlier workers, but, by the innovations mentioned above, it has been possible to correct these curves to obtain the true optical excitation function values. The corrected results show that each line has a maximum excitation probability either at or within a few tenths of a volt of the excitation potential, and that the probability drops off quite rapidly above this value, more rapidly for the triplet system than for the singlet. AUTHOR.

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957. Mobility of Aged Ions in Air. O. Luhr and N. E. Bradbury. *Phys. Rev.* 36. *pp.* 1394–1397, *Oct.* 15, 1930.—The mobility of air ions produced by X-rays has been measured by the simple Rutherford a.c. method. No change in mobility with age could be detected for ions aged as long as 1 sec. The weighted average of the results gives 1·64 ± 0·05 and 2·25 ± 0·05 cm./sec. per volt/cm. for the mobilities of positive and negative ions respectively. No completely satisfactory explanation has been found for the continual decrease in the coefficient of recombination with age while the mobility remains unchanged. When moist air from the room was substituted for carefully dried air the mobility dropped to 1·4 and 1·8 cm./sec. per volt/cm. for positive and negative ions.

AUTHORS.

958. Determination of Molecular Structure from the Deflection of Electrons by a Stream of Vapour. H. Mark and R. Wierl. *Zeits. f. Elektrochem.* 36. *pp.* 675–676, *Sept.*, 1930. *Paper read before the Deut. Bunsen-Gesell., Heidelberg, May–June,* 1930.—The wave-length associated with an electron which has been accelerated by V volts is given by the equation $\lambda = \sqrt{150/V}$ Å., so that 150 volt electrons are associated with a wave-length of 1 Å. Electrons have been found to be diffracted according to the same laws as X-rays. The latter have been shown by Debye to show interference effects after passing through vapours, and the diffraction should be greater for swiftly moving electrons. Reproduces a photograph showing the effect when 40-kV electrons are passed through a stream of CCl_4 vapour. The time required to produce a record is very small. From observations of the tetrachlorides the radii of the atoms of C, Si and Ti have been determined as 0·8 Å., 1·2 Å. and 1·5 Å. The cyclic molecules benzol, cyclohexane and cyclopentane have also been studied; the distance between the carbon atoms in the aliphatic compound is found to be 1·5 Å. and in the aromatic compound 1·4 Å. Other experiments are mentioned.

H. N. A.

959. Distinction between Contact-Potential Effects and True Reflection Coefficients for Low-Velocity Electrons. H. E. Farnsworth and V. H. Goerke. *Phys. Rev.* 36. *pp.* 1190–1194, *Oct.* 1, 1930.—A method is described for determining the apparent electron reflection coefficient in two ways in the same apparatus such that a distinction may be made between a contact potential and a true reflection coefficient for very low-velocity electrons. The results indicate that for a copper target which has been heated at red heat for some time in a high vacuum, the true electron reflection coefficient approaches a zero value as the primary voltage approaches zero, and that the apparent increase in the reflection coefficient below about 1 volt is due to a change in the contact potential between the target and the surrounding electrodes. The value of this change for the specimen tested is approximately 1·2 volts. [See Abstract 356 (1923).]

AUTHORS.

960. Effective Cross-Section Measurements of Gases and Vapours. F. Schmieder. *Zeits. f. Elektrochem.* 36. *pp.* 700–704, *Sept.*, 1930. *Paper read before the Deut. Bunsen-Gesell., Heidelberg, May–June,* 1930.—The objective of the investigations now described was to establish how different relationships between chemical compounds may be expressed by their effective cross-section curves. The paper deals with the subject-matter in three sections: (1) the relationship according to the Grimm hydride displacement law, (2) isomerism, (3) the influence of certain atomic groups with special reference to the hydroxyl group. The argument and data are illustrated by 12 diagrams. H. H. Ho.

961. Effective Cross-Section Measurements. C. Ramsauer. *Ann. d. Physik*, 6. 7. *pp.* 903–904, *Oct.* 8, 1930.—The indirect method of Townsend is first discussed where the significance of the data thereby obtained is described to the comparison available with the results by direct methods. The author then refers to his measurements of 1920 on the effective cross-section of the argon atom under various voltages which sinks rapidly as the voltage decreases, a result in conflict with the indirect method, and with the opinions of Bröse and Saayman [see Abstract 4091 (1930)], and by which the author re-emphasises his own standpoint. H. H. Ho.

962. Effective Cross-Section of Gas Molecules towards Electrons below 1 Volt. C. Ramsauer and R. Kollath. *Ann. d. Physik*, 7. 2. *pp.* 176–182, *Oct.* 31, 1930.—This paper supplements previous work [see Abstract 2284 (1930)] and includes measurements on nitrous oxide, comparison data for ortho- and para-hydrogen and a discussion of Normand's results [see Abstract 3539 (1930)]. The nitrous oxide and carbonic acid data show the like similarity with those of nitrogen and carbon monoxide; both the hydrogen modifications appear to possess the same effective cross-section, and the authors' results are held to contradict those of Normand. H. H. Ho.

963. Determination of Effective Cross-Sections for the Quenching of Mercury Resonance Radiation. M. W. Zemansky. *Phys. Rev.* 36. *pp.* 919–934, *Sept.* 1, 1930.—The problem of the quenching of resonance radiation by foreign gases is treated on the basis of Milne's theory of diffusion of radiation extended to take account of (1) a collimated incident beam, (2) a finite emission line, (3) a finite absorption line, (4) impacts of the second kind, and a curve is obtained from which one can find the number of impacts of the second kind corresponding to any experimentally observed value of the quenching. The effect of metastable atoms is discussed and a theory of their behaviour outlined. The scattered radiation emerging from an absorption cell containing mercury vapour in the presence of a foreign gas was measured as a function of the gas pressure with apparatus designed to agree closely with the requirements of the theory. From the theoretical curve the number of impacts of the second kind was obtained, and from this the effective cross-section for quenching was calculated for the following gases: O_2, H_2, CO, NH_3, CO_2, H_2O, N_2, CH_4, C_2H_6, C_3H_8, C_4H_{10}, He and A. The values of the effective cross-section for quenching are tabulated along with those for depolarisation of resonance radiation and for collision broadening. The quenching cross-sections of CO, NH_3, CO_2, H_2O, N_2, CH_4, C_2H_6 and C_4H_{10} are shown to be connected with the difference between the energy of the transition $2^3P_1 \rightarrow 2^3P_0$ of Hg and the vibrational energy of the molecules, in qualitative agreement with the theory of Kallmann and London. AUTHOR.

964. Diffraction of Material Waves. S. Kikuchi. *Phys. Zeits.* 31. *pp.* 777–791, *Sept.* 1, 1930.—The author gives an explanatory review of all the principal experimental researches demonstrating the diffraction of material waves. Part I: Diffraction of electron waves by (*a*) single crystals (Davisson-Germer, Rupp, Nishikawa and Kikuchi, Emslie and others), (*b*) crystalline powders or layers (Thomson and collaborators, Mark and Wierl, Rupp), and (*c*) individual molecules (Mark and Wierl). Part II: Diffraction of the material waves associated with atomic nuclei and molecules (Stern, Knauer, Estermann, Johnson and others). Part III: Brief discussion of the evidence concerning polarisation of material waves, pointing out the curious discrepancy between the results of Rupp's experiments on successive diffraction of electron waves and Mott's theoretical predictions. Two excellent plates of electron-wave diffraction photographs are included. W. S. S.

965. Passage of an Electron Beam through a Field-Free Enclosure. F. L. Arnot. *Roy. Soc., Proc.* 129. *pp.* 361–377, *Oct.* 1, 1930.—Two independent methods are employed: measurements of the angular and velocity distributions of the positive ions generated along the path of the electron beam; and measurement of the electron concentrations in a region around the electron beam by means of a Langmuir probe electrode. The enclosure through which the electron beam passes is filled with a gas of slow electrons, with a Maxwell velocity distribution corresponding to a temperature of several thousand degrees absolute. There are radial potential gradients around the beam, which accelerate the positive ions generated by it at right angles to its path. The intensity of the positive ionic current, and the mean velocity of the ions outside the beam, are both approximately linear functions of the density of ionisation along the path of the electron beam. H. N. A.

966. Scattering of Electrons by Atomic Fields. E. C. Bullard and H. S. W. Massey. *Cambridge Phil. Soc., Proc.* 26. *pp.* 556–563, *Oct.,* 1930.—Obtains the variation of the intensity of elastic scattering with velocity and angle of scattering by applying the Thomas-Fermi electron distribution in the atom to Born's approximate scattering formula, and discusses the conditions under which the results are valid. For heavy atoms the scattered intensity divided by the atomic number, Z, is a function of $v \sin \frac{1}{2}\theta / Z^{\frac{1}{3}}$ only, and this function is tabulated. Born's formula has been shown to be inaccurate for representing the scattering of electrons with velocities less than 400 volts, except by atoms of very low atomic number. For the case of high velocities an approximate expression is obtained for the angular distribution, allowing for screening by the extra-nuclear electrons. H. N. A.

967. Production and Control of Positive Ions. F. G. Cottrell, C. H. Kunsman and R. A. Nelson. *Rev. Sci. Instruments,* 1. *pp.* 654–661, *Nov.,* 1930.—A new method is described for the production and control of positive ions. A filament is made by shrinking a tube of potassium glass on to a platinum strip (0·5 mm. wide, 0·1 mm. thick) taking care that the glass makes a seal particularly at the ends. This glass-coated filament, bent into a U, is then immersed in a bath of molten potassium nitrate, and another platinum strip in the bath serves as the other electrode, so that potassium may be driven through the glass to the platinum filament as kathode. Thus potassium is " plated " on to the platinum filament. The glass is then removed, cleaned and coated with platinum by sputtering. The whole affair is then used as a hot anode in a vacuum, the concentration of potassium ions on the surface being controlled by electrolysis through the glass. Experiments were made in this source and on blanks, and it is concluded that the emission can be made very pure, constant for a long time, and the magnitude of the positive ion current can be varied while the temperature remains constant by varying the electrolysis potential difference. [See also following Abstract.] A. C. M.

968. Photoelectric and Thermionic Properties of Platinum-Coated Glass Filaments. A. K. Brewer. *Phys. Rev.* 35. *pp.* 1360–1366, *June* 1, 1930.—The photoelectric and thermionic properties of platinum-sputtered glass filaments are discussed, special attention being given to the effect of temperature and to the electrolysis of potassium through the glass to or from the sputtered coating. When electrolysis is away from the surface the photoelectric threshold is independent of the temperature up to 450° C. and is close to 2720 Å. With electrolysis towards the surface the threshold remains at 2720 Å. up to 260° C., above which it shifts toward the red with rising temperature, reaching a maximum value of about 4300 Å. at 410° C. Electrolysis produces identical effects on the photoelectric and thermionic emissivity for electrons; the effect on positive-ion emission is also similar, except that a peculiar maximum in the emissivity occurs for a specific electrolysis potential. Ultra-violet radiation has no effect on the thermionic emission of electrons or positive ions from this type of filament. [See also preceding Abstract.] AUTHOR.

969. Photoelectric Action of the Neon Lamp. N. Carrara. *N. Cimento,* 7. *pp.* 318–325, *Aug.-Sept.-Oct.,* 1930.—When an ordinary neon lamp is illuminated, the voltage at which discharge sets in and the voltage at which it stops both diminish by 2 or 3 volts. The electrodes are made of iron covered with potassium, and act photoelectrically. The author demonstrates this action by means of a sensitive galvanometer, and shows how light may be made to influence the period of oscillatory discharges obtained with a neon lamp. E. E. F. d'A.

970. Photoelectric Effect in Metals. H. Fröhlich. *Ann. d. Physik,* 7. 1. *pp.* 103–128, *Oct.* 23, 1930.—A theory of the photo-effect at thin metallic sheets is developed on the basis of Sommerfeld's theory and Wentzel's treatment. This theory agrees in all essential points with experiment. In the alkalies the distribution of intensities gives the position of the selective maximum if the limiting frequency is known at all accurately. The heavy metals exhibit maxima which near the limit of experiment. The difference between normal and selective effect is only due to surface conditions. It will be necessary to define the influence of the surface more accurately and especially to determine the absorption coefficients of both electrons and light separately. E. E. F. d'A.

971. Photoelectric Cells in Industrial Processes. C. A. Styer and E. H. Vedder. *Indust. and Engin. Chem.* 22. *pp.* 1062–1069, *Oct.,* 1930.—A summary of present and prospective uses of photoelectric cells in various manufactures, together with instructions concerning the use of cells with thermionic amplifiers and grid glow tubes. Attention is drawn to the growing importance of substituting continuous processes for batch processes. The speed of operating depends upon the inertia of the various moving parts. A relay can react within 0·001 sec. E. E. F. d'A.

972. Photoelectric Cells in Chemical Processes. A. J. McMaster. *Indust. and Engin. Chem.* 22. *pp.* 1070–1073, *Oct.,* 1930.—Describes the various types of photoelectric cell used in chemical processes. Where constancy is important, only vacuum cells should be used. An arrangement is described for automatic indication of titration in chemical mixtures, and another for measuring the densities of spectrum lines on photographic plates. E. E. F. d'A.

973. Photoelectric Cell Suitable for Photometry. R. Suhrmann. *Zeits. f. wiss. Phot.* 29, 1–12. *pp.* 156–159, 1930.—The chief faults encountered in photoelectric cells used for photometry are insufficient insulation, electrostatic disturbances, excessive sensitiveness near the selective maximum, and, in the case of polarised light, dependence upon the orientation of the plane of polarisation. The author uses a kathode mounted in a quartz plug, while the almost complete silvering of the wall serves as anode. The polarisation difficulties are eliminated by depositing a monomolecular layer of cæsium on platinum on a silver kathode. E. E. F. d'A.

974. Inertia of Gasfilled Photoelectric Cells. F. Schroeter and G. Lubszynski. *Phys. Zeits.* 31. *pp.* 897–904, *Oct.* 15, 1930.—Investigates the inertia of recombination of the ions which render the larger currents possible in photoelectric cells. In the reproduction of sounds it is possible to minimise the disturbing effect affecting the frequency by superposing another frequency by means of a revolving hole-plate. But this cannot be done in television frequencies as the hole-plate cannot be driven at sufficient speed. The authors have therefore adopted the new photoelectric note siren of the Telefunken laboratory, which allows a rapid measurement of the frequency characteristic of the amplifier. Studying various gases, the authors find that helium and neon form ions with any gas present in traces, which produce conductivity by ionisation and show inertia. This does not happen in argon or hydrogen. E. E. F. d'A.

975. Improvement of Thin Film Cæsium Photoelectric Tube. S. Asao and M. Suzuki. *Phys. Math. Soc. Japan, Proc.* 12. *pp.* 247–250, *Oct.*, 1930. *In English.*—A thin film of caesium deposited on caesium oxide with silver as base metal used as a kathode of a photoelectric tube was studied by L. R. Koller [see Abstract 1593 (1930)]. This kathode has a maximum sensitivity in the short wave and at the same time a remarkable hump in the red, and long-wave limit λ_0 moves out toward the infra-red. If a thin layer of Ag or Au is deposited on the above kathode and baked afterward, it becomes very sensitive and shows displacements of the hump and λ_0 to the longer wave-length. By this method a current is obtained of 40 microamps, sometimes even 48 microamps per lumen at vacuum from gasfilled lamp at 2700° K., which is about thirty times as large as obtained by a potassium hydride tube. The new kathode may be considered to have a thin film of caesium over its uppermost surface and below it lies the evaporated thin silver layer. An increase in sensitivity is also obtained by using K or Rb instead of Cs. AUTHORS.

976. Photo-Ionisation of Cæsium Vapour by Absorption between the Series Lines. C. Boeckner and F. L. Mohler. *Bureau of Standards, J. of Research,* 5. *pp.* 831–842, *Oct.*, 1930.—Measurements by the space-charge method have been made on photo-ionisation resulting from a small continuous absorption between the series lines. Results are expressed in terms of relative sensitivity I (λ)/I (3200). At 0·064 mm. pressure I (λ)/I (3200) increases from 0·0003 at 3750 Å. to 0·07 at 3250 Å. I (λ)/I (3200) increases roughly as the square root of the pressure throughout this wave-length range. On the short wave-length side of 3500 Å. the effect decreases with increasing temperature of the vapour, the effect being reduced to half for a 70° rise in temperature. On the red side of

3500 Å. there is little, if any, temperature change. Results other than the temperature effect can be explained on the hypothesis that the absorption between lines is purely atomic as there is some line absorption far from the line centre. However, the temperature variation indicates a molecular origin and leads to an estimate of 0·26 electron volts for the work of dissociation of Cs_2. Other results can be qualitatively explained on the same hypothesis. AUTHORS.

977. Thermionic Emission of Oxide-Coated Kathodes Containing a Ni-Ba Alloy Core. N. C. Beese. *Phys. Rev.* 36. *pp.* 1309–1313, *Oct.* 15, 1930.—An appreciable increase in thermionic emission from oxide-coated filaments has been obtained by introducing a small percentage of metallic barium (approximately 0·15 %) into the nickel core material. Comparisons made on the electron emission of this alloy with pure nickel and also with the nickel alloy after the barium had been extracted always showed the influence of barium in the base metal. AUTHOR.

978. Shot Effect of Tungstic Oxide Ions. J. S. Donal, Jr. *Phys. Rev.* 36. *pp.* 1172–1189, *Oct.* 1, 1930.—When positive ions of tungstous and tungstic oxides are trapped in the minimum of potential surrounding a hot kathode, an abnormal shot voltage results. This abnormality is found to vary inversely with the square of the resonance frequency of the tuned shot circuit, analogously with the " flicker effect." An expression for the mean square shot voltage is developed, which permits the calculation of the average plate current increase due to the trapping of a single ion. E. E. F. d'A.

979. Shot Effect of the Emission from Oxide Kathodes. H. N. Kozanowski and N. H. Williams. *Phys. Rev.* 36. *pp.* 1314–1329, *Oct.* 15, 1930.—Experimental procedure in the study of fluctuations in the space current of a thermionic emitter is outlined. A new method of measuring shot-circuit impedance is introduced. Conditions under which the observed fluctuations may be applied to determine the electronic charge are pointed out. A method is described whereby the frequency of oscillating circuits used in this investigation may be determined and controlled. An investigation has been made of the fluctuations associated with the emission from barium-strontium oxide kathodes, particularly in the space-charge region. The presence of positive ions in the emission from oxide coatings has been experimentally verified. These positive ions moving in an electron space charge cause abnormally high shot-fluctuations in an aperiodic circuit at high amplifier frequencies. The characteristic fluctuations associated with the emission from oxide kathodes have been reproduced in a vacuum tube of special design in which positive ions from an independent Kunsman potassium ion emitter interact with electron space charge about a metal emitter. This is taken as evidence that the same process goes on in the emission from barium-strontium oxide kathodes. Some results obtained in a study of the shot effect of films evaporating from a tungsten wire are included. AUTHORS.

980. Behaviour of Short A.C. Arc at Zero Current Value. M. Steenbeck. *Zeits. f. Physik,* 65. 1–2. *pp.* 88–91, 1930.—Oscillograms were taken with a Braun tube, and it was found that, if the e.m.f. between the electrodes fell off quickly enough compared with the loss of ionisation of the gas and the cooling of the electrodes, a current flowed through the arc at small voltages, which was proportional to the voltage dropping to zero at zero voltage and rising to a positive value as the voltage increased up to a certain point. It was due to the ions still present in the gas and the electrons emitted by the hot electrodes, and its amount seemed to depend on the resistance in circuit with the arc. At a certain small voltage the current suddenly began to diminish, owing to the fact that comparatively few ions were left, and that there was thus no positive space charge to balance the negative space charge due to the electrons from the electrodes and allow them to convey the current. This could only increase again when the voltage reached the point when ionisation by collision could occur, and new positive space charges could be produced. About 25 volts was apparently required for this, at which point the arc lit up again, the current increasing very rapidly. H. N. A.

981. Possibilities of the Oscillating Arc in Spectrochemical Analysis. E. Z. Stowell and W. S. Huxford. *Phys. Rev.* 36. *pp.* 1348–1351, *Oct.* 15, 1930.—It is shown experimentally that none of the alkali metals will allow radio-frequency oscillations to be generated across an arc in hydrogen, but that the alkaline earths will do so: a confirmation and extension of previous work [see Abstract 758 (1930)]. Spectra have been photographed of the two groups of elements when burned in the hydrogen arc, and the intensification and reduction of the lines of various elements is described. The effect of a minute quantity of Mg in large amounts of Rb and Na is described in detail, as well as the method by which a quantitative estimate of the amount might be reached. No satisfactory explanation for the complicated phenomena of the oscillating arc has yet been found. AUTHORS.

982. Barkhausen-Kurz Effect. K. Schuster. *Ann. d. Physik*, 7. 1. *pp.* 54–64, *Oct.* 23, 1930.—The Barkhausen-Kurz effect [see Abstract 908 (1920)] is under simplifying assumptions treated according to wave mechanics. It appears that the distances of neighbouring energy levels, starting from the ground-level, at first decrease, reach a minimum and then again increase. Thus a system of spectral lines arises which has a certain similarity with a band system. The band edge of the longest waves accords with the wave-length calculated by Barkhausen and Kurz. J. J. S.

983. Effect of a Circular Alternating Field on the Discontinuities of the Magnetisation of Iron. S. Procopiu. *J. de Physique et le Radium*, 1. *pp.* 306–313, *Sept.*, 1930.—The discontinuities of magnetisation of a ferromagnetic substance, the so-called Barkhausen effect, are increased when an a.c., producing a circular alternating field, is passed through a wire of the substance. This has been studied for iron and for steel, the axial a.c., and the independent magnetising field employed being varied. The alteration in the Barkhausen effect is explained by the increases in the intensity of the magnetisation owing to the action of the a.c. The fact that the Barkhausen effect is much smaller for a tube full of iron filings than for an iron wire is explained. Describes a new magnetic effect, due to the discontinuities of magnetisation. When an a.c. is passed through an iron wire, which is not magnetised by a separate field, induction phenomena are produced, as in the Barkhausen effect, as soon as the circular alternating field due to the a.c. reaches a maximum value, equal to the coercive field of the ferromagnetic substance employed. H. N. A.

984. Barkhausen Effect. A. Cisman. *Ann. d. Physik*, 6. 7. *pp.* 825–851, *Oct.* 8, 1930.—The apparatus is described and the records given of a method for the experimental investigation of the Barkhausen effect, in circular discs of ferromagnetic material which are rotated in a magnetic field. It is shown that as the disc is turned there is an angle within which, whether the movement is backward or forward, there is no Barkhausen effect. This angle, designated as 2α, can be considered as double the angle ϕ, enclosed by the field vector and the vector of induction. This angle is measured and it is shown that before saturation is reached, it is practically negligible, approaching asymptotically the value zero. The angle 2α is independent of the velocity of movement. The Barkhausen effect is measured for a number of ferromagnetic materials and is found to assume a maximum value for a definite field strength entirely independent of the velocity of movement. The maximum of the Barkhausen effect occurs at field strengths considerably below that at which saturation is created. Long before saturation is reached the effect is practically nil. Therefore it follows that at saturation the hysteresis loss likewise almost disappears. For constant field strengths the effect increases with the velocity. The oscillographs of the Barkhausen effect are recorded and the consequences upon asymmetrical configurations discussed. Geometric asymmetry of discs in which the quantity of the ferromagnetic material in the disc only shows a weak Barkhausen effect can materially augment the value of the effect. S. G. B.

985. Ferromagnetism and Electrical Characteristics. Part I. W. Gerlach and K. Schneiderhan. *Ann. d. Physik*, 6. 6. *pp*. 772–784, *Sept*. 25, 1930.—Considers the resistance, magnetic resistance variation and true magnetisation at the Curie point. From systematic measurements of the field and temperature relationships of the magnetic resistance decrease in the region of the Curie point, it is found that the resistance anomalies in this region depend upon the transition from the spontaneously magnetised condition to that of the non-magnetic state. The temperature relationship of the resistance with no external magnetic field consists of two terms, one directly proportional to the temperature and the other showing the resistance decrease as proportional to σ^2. The anomaly is increased, by the use of an external longitudinal field, in the temperature region of true magnetisation, this resulting in a reduction of resistance. [See also Abstract 2297 (1930).] R. C. F.

986. Proof of Impossibility of Spontaneous Magnetisation. N. S. Akulov. *Zeits. f. Physik*, 64. 7–8. *pp*. 559–562, 1930.—If the supposition of spontaneous magnetisation is correct, it is impossible by means of it to reconcile the facts that ferromagnetic crystals (1) exhibit sharply marked anisotropy and (2) have extremely small hysteresis losses. G. E. A.

987. Principles of Atomic Moments in Ferromagnetic Alloys and their Unity. R. Forrer. *J. de Physique et le Radium*, 1. *pp*. 325–339, *Oct*., 1930.—The discussion centres on the assumption that one replaces in the network structure of a ferromagnetic body a very small number of atoms by atoms of another body. The magnetic moment of the alloy will be altered. The variation of the moment per replaced atom is styled ΔM, and it is the purpose of the present paper to investigate the distribution of the newly acquired moment in the atomic structure. The quantity ΔM is capable of experimental measurement as the declivity of the curve showing the variation of the mean moment of the alloy per substituted atom. For the alloys studied, *viz*., nickel-cobalt, ferro-nickel, ferro-cobalt, the value of ΔM is found to be almost without exception a

V.3
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whole-number multiple of the Weiss magneton. In order to distribute the mean moment throughout the atoms present in the alloy it is necessary to hypothesise that either there is (1) a simple substitution or (2) the substitution is accompanied by a transformation of the moment from one or several neighbouring atoms. The consideration of the whole range of the facts renders it possible that there are created a certain number of new moments for the atoms in the alloys. The most certain of them all seems to be the value 14 for the atom of iron. It is possible to interpret a large number of the rectilinear variations by a relatively small number of the different moments attributed to different atoms. S. G. B.

988. Magnetic Properties of Metals. F. Bitter. *Phys. Rev.* 36. *pp.* 978–983, *Sept.* 1, 1930.—It is shown that the susceptibility of copper and silver is structure sensitive. Annealing increases the diamagnetism and drawing decreases it. It is suggested that uncertainty concerning the state of a metal as well as uncertainty concerning its purity may account for the large spread of observed values of the susceptibility. It is shown that the Pauli paramagnetism of the free electrons and the diamagnetism of the ions taken together are not sufficient to explain the susceptibility of the alkali metals. It is suggested that partly bound electrons should be taken into consideration. Several effects are predicted by means of which the total susceptibility can be analysed and its component parts measured separately. AUTHOR.

989. Paramagnetism of Metals. L. Landau. *Zeits. f. Physik,* 64. 9–10. *pp.* 629–637, 1930.—The author shows mathematically that, according to quantum theory, even free electrons, in addition to their spin-paramagnetism, possess another type of paramagnetism, which is not zero, and which is attributable to the partially finite character of the electronic orbits. Other possible consequences of this finite character of the orbits are briefly referred to. J. S. G. T.

990. Magnetisation of Nickel Wire under Great Stress. R. Becker and M. Kersten. *Zeits. f. Physik,* 64. 9–10. *pp.* 660–681, 1930.—The influence of elastic distortion on the magnetisation curve was quantitatively examined for nickel wire which was subjected to a strong external stress. For the case in which this tension is great compared with the internal tension, the theory yields a simple law for the magnetostriction which is quantitatively established by experiment. The magnetostriction in nickel wire under great stress is exactly 50 % greater than that in nickel free from tension. The basic formula for the energy of the distorted dipole lattice was so corrected that it yielded accurately the measured values of the magnetostriction. J. J. S.

991. Sudden Variations in the Magnetisation of Nickel. B. del Nunzio. *N. Cimento,* 7. *pp.* 305–317, *Aug.–Sept.–Oct.,* 1930.—Observes the discontinuities found in the magnetisation of nickel treated by Forrer's methods of mechanical deformation and their dependence upon temperature and manner of magnetisation. Describes a special apparatus designed for their photographic registration, and concludes from a comparison of the behaviour of various irons and alloys that the discontinuities are characteristic of nickel. E. E. F. d'A.

992. Nature of Remanence and Hysteresis Loss. N. S. Akulov. *Zeits. f. Physik,* 64. 11–12. *pp.* 817–829, 1930.—It is in harmony with experience that the single ferromagnetic crystal has no remanence and no hysteresis loss, these properties being confined to the polycrystal. They are produced by mutual elastic action, and deformation of the elementary crystals. General formulæ are given for the energy, remanence and hysteresis loss of an elastically deformed crystal, and properties of ferromagnetic bodies are explained. Ferromagnetics with the least possible hysteresis must have a minimum of internal elastic stress; suitable substances are alloys whose single crystals possess extremely small magnetostriction. A case in which there is a vanishing amount of remanence combined with comparatively large hysteresis loss is explained, and is exemplified in the alloy perminvar. G. E. A.

993. Simple Accurate Method for Measuring the Diamagnetic Susceptibility of Dissolved Substances. S. Freed and C. Kasper. *Phys. Rev.* 36. *pp.* 1002–1004, *Sept.* 1, 1930.—A quasi-null method has been developed for determining very accurately the diamagnetic susceptibility of dissolved substances. Two independent runs with 2·521 M. sodium iodide agreed easily within ± 0·06 %. Its advantages over other methods are discussed. Several other kinds of investigations to which this method may be applied are pointed out. AUTHORS.

994. Thermal Variation of the Magnetic Susceptibility of Water. B. Cabrera, W. Johner and A. Piccard. *Comptes Rendus,* 191. *pp.* 589–591, *Oct.* 13, 1930.—The values found by different authors for the temperature coefficient of the susceptibility of water per unit of mass are collected and discussed. Piccard and Johner give it as + 0·000131 at 20° C. Cabrera and Duperier are measuring it, and their result agrees in sign with that given. G. E. A.

995. Change of Temperature Accompanying Change of Magnetisation of Iron. W. B. Ellwood. *Phys. Rev.* 36. *pp.* 1066–1082, *Sept.* 15, 1930.—A description of apparatus for the measurement of the spontaneous change in temperature of a ferromagnetic material consequent upon any change in its magnetisation. A test specimen of particular form is placed in a calorimeter the outer surface of which is wound as a solenoid. Thermal and thermoelectric disturbances are minimised and the temperature change recorded by 102 thermocouples in series with a sensitive galvanometer. Temperature changes of $2 \cdot 26 \times 10^{-6}$° C. are detectable, *i.e.*, a thermal energy change of 87 ergs per cm.^{3} for steel. Two series of results are quoted for steels of carbon content 1·08 % and 1·35 % respectively, showing the relationship between temperature change and magnetising field as the material is taken through symmetrical and asymmetrical cycles of magnetisation. Sharply defined regions of heating and cooling are characteristic of the different asymmetric cycles investigated. The total hysteric heat developed for cycles approaching saturation, depends on the rate of performance of the cycle: a more rapid traversal yielding a greater total heat. S. G. B.

996. Anomalous Diamagnetism and Crystal Structure. V. I. Vaidyanathan. *Indian Journ. Phys.* 5. 5. *pp.* 559–572, *Oct.*, 1930.—Colloids of graphite, antimony and bismuth have been magnetically investigated, using a magnetic balance of the Curie type, the torsion of a quartz fibre, produced by the diamagnetic force being recorded by the deflection of an attached mirror with lamp and scale, whilst the magnetic field was maintained by means of a large electromagnet with inclined polepieces. Full details of the experimental precautions, etc., are recorded in a previous paper by the same author [see Abstract 1721 (1928)]. The three elements, graphite, antimony and bismuth, possessing respectively anomalous diamagnetism of $61 \cdot 2 \times 10^{-6}$, 93×10^{-6} and 250×10^{-6} for regulus at atmospheric temperature, showed a decrease in diamagnetism on colloidisation, which was more pronounced in graphite than in the two others. The anisotropy of single natural crystals of graphite showed that the anisotropy had a value of $1 : 6 \cdot 7$ when the axis lay vertical and parallel to the field respectively. The ionic values for compounds of Bi and Sb are much smaller than in the crystal state, and numerical examples are quoted. The decrease in colloidisation is attributed as being due to the existence of large electron orbits comprising groups of molecules in the macrocrystal, the valency electron circuits in these equipotential surfaces being also conducting surfaces. The anomalous diamagnetism of these elements is in perfect harmony with the similarity of structure and other properties, whilst the structure indicated for graphite, namely, nineteen benzene rings in the cleavage plane, conforms to the X-ray investigations of Debye and Scherrer. S. G. B.

997. Statistical Theory of Para- and Diamagnetism. E. Howells. *Phil. Mag.* 10. *pp.* 698–711, *Oct.*, 1930.—The theory is a generalisation of Langevin's, developed somewhat on the lines of Gans, assuming that the magnetisation of the molecules arises from their angular motions and is influenced by magnetic forces. Classical treatment seems adequate to give a general description of the facts. The paramagnetism appears as the Curie term, varies inversely with absolute temperature and depends on the permanent molecular angular momentum. The diamagnetism is constant, independent of temperature and depends on the induced angular momentum. Permanent magnetism is due to a molecular field. Even at low temperatures the theory is successful. When Planck's function $f(R\theta)$ is substituted for $R(\theta)$ the probability of saturation over a range of temperature just above absolute zero is indicated; this agrees with experiments. An attempt has been made to make use of quantum mechanics. It is necessary to have further knowledge of how and when the intra-molecular forces assert themselves with falling temperature. This involves an acquaintance with the structural form of the medium. H. N. A.

998. Paramagnetic Characteristics of Molecules and Their Chemical Constitution. D. M. Bose. *Zeits. f. Physik,* 65. 9–10. *pp.* 677–699, 1930.—A comparison is made between the simple and complex compounds of paramagnetic elements which belong to the various transition groups. In a series of halogen compounds of corresponding elements of the various transition groups an unstable change of the magnetic behaviour is found, *i.e.*, in the series $NiCl_2$, $PdCl_2$, $PtCl_2$, the first compound is paramagnetic whilst the two others are diamagnetic. The group of complex compounds contains four or six atom groups which are so combined with a paramagnetic atom that they form a complex which has a determined positive or negative electro-valency. According to their magnetic behaviour they may be divided into three sub-groups. (1) Hydrated salts of elements which belong to the first transition group. (2) A number of tetramino-complexes of Ni and Cu, like similar hydrazin-complexes of Mn, Fe, Co and Ni in which a small but significant lessening of the magnetic moment of the kation compared with that in the corresponding simple salt is observed. (3) Complexes of paramagnetic elements which are either diamagnetic or in which a strong lessening of the magnetic moment in the central atom is observed, or complexes whose electro-valency is changed by the substitution of one coordinating group or of one coordinating molecule by another. J. J. S.

999. Thermomagnetic Property of Manganese. Y. Shimizu. *Tohoku Univ., Sci. Reports*, 19. *pp.* 411–417, *Oct.*, 1930. *In English. Report No.* 250 *from the Research Inst. for Iron, Steel and Other Metals.*—The thermomagnetic property of manganese has been studied by others, whose results, however, are not sufficiently accurate, as formerly manganese was not obtained in a very pure state; moreover, a discontinuous change of susceptibility observed at 1040° was not attributed to a modification of manganese. The author has studied the modification of this metal by measuring its susceptibility at different high temperatures, the purity of the metal being 99·9 %. The magnetic susceptibility of manganese at room temperature is $7 \cdot 55 \times 10^{-6}$, a value which is smaller than that obtained by previous investigators; further, it has been determined that the transformation point of α to β manganese is 810° and that of β to γ manganese 1100°, and that the magnitude of the change of the susceptibility at the former transformation point is much smaller than that at the latter. AUTHOR.

1000. Electromagnetism and the Principles of Mechanics. A. Schidlof. *Arch. des Sciences*, 12. *pp.* 340–356, *Sept.–Oct.*, 1930.—The subject is treated historically, and it is shown how it has been necessary, in order to unify the subject of mechanics as developed by Newton and the electromagnetic theory of Maxwell, to introduce the conception of four dimensional space-time, the limiting velocity *c*, the variation of mass with velocity, relativity, wave mechanics and the quantum theory. Deals briefly with the theories of Boltzmann, Lorentz, de Broglie, Einstein, Weyl, Pauli, Sommerfeld, Schrödinger, Bloch, Haas and Dirac. It seems possible to hope that further researches may lead to the abolition of any separation between electromagnetism and mechanics, and that theoretical physics, in spite of the apparent disorder of the different facts disclosed by observation, will continue to progress towards unity. H. N. A.

1001. Direction of Lines of Force at Points with Vanishing Field Intensity. J. Jaumann. *Zeits. f. Physik*, 65. 5–6. *pp.* 330–333, 1930.—Proves that at points where the field intensity vanishes, the lines of force do not cut the equipotential surfaces at right angles. With uncharged conductors placed in an external field the lines of force which enter and leave the lines bounding the surface charges of opposite sign make angles of 45° with the surface and with the equipotential surface which leaves it at right angles. H. N. A.

1002. Motion of a Particle in a Potential Field and the Propagation of Electromagnetic Waves. W. de Groot. *Phil. Mag.* 10. *pp.* 521–540, *Oct.*, 1930.—The conditions are discussed under which an equation of the form $\Delta\phi + \frac{\omega^2}{u^2}\phi = 0$ can represent a group of waves moving like a mass-point in a field of force whose potential is independent of the frequency of the group. This leads to Schrödinger's equations (relativistic or non-relativistic) for the dependence of ω on u. If electromagnetic waves move through a medium containing charged particles, the wave-motion of a group can be represented as the movement of a mass-point in a field where the potential depends on ω. The theory is applied to the calculation of the height of the Heaviside layer for wireless waves and the solution is shown to depend on an integral equation whose solution is known. The bending of the rays round the earth and the calculation of the "effective height" are also discussed. G. C. Mc V.

1003. Generalisation of the Equations of the Electromagnetic Field. B. Lagunoff. *Zeits. f. Physik*, 64. 5–6. *pp.* 425–430, 1930.—Tensor equations for the general matter field are derived based on the introduction as field tensor of an asymmetric tensor N including both the mechanical and the electromagnetic field tensors, in place of the antisymmetric tensor M representing only the electromagnetic field tensor. W. S. S.

1004. Wave Forms and a Special Problem. R. Hargreaves. *Cambridge Phil. Soc., Proc.* 26. *pp.* 438–445, *Oct.*, 1930.—Discusses the electromagnetic potentials for a source assuming different metrical forms, as examples of Whittaker's recent theory [see Abstract 3067 (1928)]. W. S. S.

1005. Statistical Evaluation of Coulomb's Energy of Interaction in a Molecule. L. Goldstein. *Comptes Rendus*, 191. *pp.* 606–608, *Oct.* 13, 1930.—Fermi's function of atomic repartition is applied to the calculation of the Coulomb energy of the two atoms forming a molecule which up to the present has almost escaped direct calculation. As the function of repartition contains implicitly the interaction of atomic electrons between themselves as well as with the nucleus, the Coulomb energy calculated by Fermi's function should give a representation of electric coupling which does not differ much from the reality. **Errata,** *ibid.* p. 972, Nov. 17, 1930. J. J. S.

1006. Determination of the Specific Charge of the Electron by the Refraction of X-Rays. H. E. Stauss. *Phys. Rev.* 36. *pp.* 1101–1108, *Oct.* 1, 1930.—The discrepancies in the determination of the value of the fundamental constant e/m by the two different methods developed so far make desirable the development of new methods for its evaluation. The index of refraction of X-rays offers one method. According to the theories developed so far, in the case of a dispersive medium with no critical frequencies near the frequency of the incident radiation, the value of e/m may be expressed in terms of well-known constants, the wave-length of the incident radiation, and δ (one minus the index of refraction). A new method of using the prism with X-rays has been developed and used to determine δ. For crystalline quartz of density $2\cdot6480$ gm./cm.^{3}, δ was determined for the Kα_1 radiation of molybdenum as $1\cdot804 \pm 0\cdot001 \times 10^{-6}$ and for the Kβ as $1\cdot436 \pm 0\cdot001 \times 10^{-6}$. The calculation of e/m is complicated by the discrepancies that have arisen in the absolute determinations of X-ray wave-lengths. Using the absolute wave-lengths as determined from the results of Bäcklin, Bearden and Cork, the values of e/m all lie between the values given by the spectroscopic and deflection methods, and they have nearly as great a range as the difference between the two older values. For this reason no definite conclusion can be made as to the most probable value of e/m. AUTHOR.

APPARATUS AND INSTRUMENTS.

1007. Design of Vacuum Pre-Baking Furnace. L. R. Hafstad and O. Dahl. *Rev. Sci. Instruments*, 1. *pp.* 517–522, *Sept.*, 1930.—A description is given of a simple type of vacuum pre-baking furnace which has proved to be both economical and serviceable. The design embodies the experience of several laboratories with such furnaces so that most of the troublesome features and unnecessary complications have been eliminated. While this particular design is not unique and may be readily modified, the description does call attention to a number of important considerations which must be taken into account in building any furnace of this kind. AUTHORS.

1008. Modified Design of Electric Resistor Furnace. F. H. Schofield. *Journ. Sci. Instruments*, 7. *pp.* 287–289, *Sept.*, 1930.—A description is given of a furnace embodying a novel design of heating element intended to be of nickel-chromium or similar alloy. A number of longitudinal strips of the metal are arranged to form a cylinder, and their ends are bent outwards at right angles and clamped between two pairs of brass rings which serve as electrodes. With this arrangement the tendency of a hot spot, due to a flaw or other cause, to spread is considerably minimised as compared with the usual form of spiral winding. This feature gives a long life to the heating element, which has the further advantages of ease of assembly and of adjustment for temperature uniformity. AUTHOR.

1009. Use of the Kerr Effect to Measure Rapidly Changing Potentials. K. Hoffmann. *Phys. Zeits.* 31. *pp.* 841–849, *Oct.* 1, 1930.—In view of the fact that the relaxation interval of the Kerr effect is less than 10^{-8}, and that resistance of chlorbenzene and carbon bisulphide is high, while the capacity of a Kerr cell is independent of the potential applied, the author develops two methods of using it for measuring variable potentials. It is shown that the measurements usually made with an electrostatic voltmeter can be carried out by means of a Kerr cell.

E. E. F. d'A.

1010. Measuring Apparatus with Electromagnets. L. Quevron. *Comptes Rendus*, 191. *pp.* 604–606, *Oct.* 13, 1930.—The author gives a further account of his method of converting laboratory electromagnets into galvanometers or millivoltmeters [see Abstract 2823 (1929)]. In the apparatus with pivots the use of which is described, the coil is rectangular, with 100 turns and moves in a radial magnetic field obtained by rigorous centring of the pieces bounding the gap. The coil is 1 mm. thick, the gap has a width of 1·5 mm. and the field is 35,000 gauss. A current of 5×10^{-9} amperes can be observed and hence a power of 10^{-15} watts. A suspension apparatus with uniform field is also described. J. J. S.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

1011. Relationship of Adsorption in Solutions to the Dielectric Properties of the Solvent. Part I. E. Heymann and E. Boye. *Zeits. f. phys. Chem.* 150. *Abt. A.* 3–4. *pp.* 219–256, *Oct.*, 1930.—This comprehensive paper discusses the relationships to be expected between the dielectric structure (molecular polarisation, molecular refraction and dipole moment) of solvents and the adsorption therefrom of a solute by an adsorbent. The difficulties encountered and their causes and the relationships with the problems of colloidal chemistry are also considered. The adsorbent used was an exhaustively purified almost ash-free wood charcoal. Regularities occur principally with solvents which are chemically related, *e.g.*, homologous series of alcohol, where the adsorptivity of a dissolved substance (benzoic acid, picric acid) decreases with increasing deformity of the alcohol. Solvent mixtures have given very good relationships, and rectilinear adsorption curves were obtained when both components of a solvent mixture were non-polar, and curvilinear when polar. The different cases of combinations of non-polar and polar components are considered and a final section is devoted to adsorption relationships with other physical properties such as vapour pressure and solubility.

H. H. Ho.

1012. Calorimetric Determinations of Heat of Adsorption. A. Magnus, H. Giebenhain and H. Velde. *Zeits. f. phys. Chem.* 150. *Abt. A.* 3–4. *pp.* 285–294, *Oct.*, 1930.—The heat of adsorption of SO_2 by wood charcoal is both integrally and differentially determined directly for values of 0·05 to 69 mg. on 1 gram. charcoal. At first the curves are steep, then they become flatter and fall regularly. The differences shown between the two curves are considered qualitatively from the point of view of the structure of the charcoal. [See also Abstract 809 (1930).] J. K.

1013. Relation between Gaseous Content and Adsorption of Electrolytes by Activated Carbon. Part IV. Adsorption of Acids by Degassed and Hydrogenated Carbon. R. Burstein, A. Frumkin and D. Lawrowskaja. *Zeits. f. phys. Chem.* 150. *Abt. A.* 5–6. *pp.* 421–438, *Oct.*, 1930.—Prolonged heating *in vacuo* at 1000° C. yields a carbon which does not adsorb hydrochloric acid from dilute solutions ($<0{\cdot}02$N) in the absence of oxygen. In concentrated solutions under the same conditions, molecular adsorption of acid occurs, increasing rapidly with the concentration. In solutions of KCl degassed carbon shows considerable negative adsorption. After admission of oxygen to degassed carbon, hydrochloric acid is adsorbed from dilute solutions in quantity equivalent to the oxygen available, so long as the latter does not exceed certain limits. Heating *in vacuo* diminishes the capacity of activated carbon of assuming the oxygen potential in the presence of air, and the adsorption of acid from dilute solutions is reduced by degassing. On the other hand the molecular adsorption in concentrated solutions is increased, so that the adsorption isotherms of degassed and non-degassed carbon taken in air intersect. Platinised carbon saturated with hydrogen shows a negative adsorption in dilute solutions of sulphuric, hydrochloric and hydrobromic acids, decreasing in this order. At higher concentrations this changes to

a positive adsorption, which, as in the case of degassed carbon, is to be considered as a molecular adsorption. [See also Abstract 2849 (1929).]
A. J. M.

1014. Adsorption of Methane and Hydrogen on Charcoal at High Pressure. K. Frolich and A. White. *Indust. and Engin. Chem.* 22. *pp.* 1058–1060, *Oct.* 1, 1930.—Adsorption isotherms of methane and of hydrogen on charcoal have been determined over the pressure range of 1 to about 150 atmospheres at temperatures of 25° and 100° C. for hydrogen. The amount of gas adsorbed increased markedly with pressure, approaching a saturation value at 80–100 atmospheres. At 25° C. the maximum adsorption is approximately 12 and 4 litres per 100 gm. of charcoal for methane and hydrogen, respectively. Experiments with mixtures of methane and hydrogen under pressure at 25° C. have shown that charcoal adsorbs methane preferentially to the practically complete exclusion of hydrogen. The amount of methane adsorbed is approximately equivalent to that which would be adsorbed if the gas were present alone at a pressure equal to its partial pressure in the mixture. AUTHORS.

1015. Sorption of Carbon Tetrachloride at Low Pressures by Activated Charcoals. Part II. Isothermals at 25° C. Part III. Isosteres—Discussion. A. J. Allmand and R. Chaplin. *Roy. Soc., Proc.* 129. *pp.* 235–266, *Oct.* 1, 1930.—The adsorption isotherms and isosteres of CCl_4 on six different activated charcoals have been determined over the pressure range of approximately 10^{-3}–10^{-1} mm. and at temperatures varying from 0°–90° C. From the isosteres the heats of adsorption have been calculated. It is found that both the isotherms and isosteres are influenced by the gradual displacement of gases from the surface of the charcoal during the experiments. It is concluded that all charcoal surfaces and more particularly their " active centres " are initially poisoned by a residual charge of oxygen which is gradually displaced by the action of the sorbate in the form of CO_2 and CO. No finally definitive results are possible until this displacement is complete; in fact, the residual oxygen surface charge sometimes causes hysteresis. [For Part I see Abstract 997 (1929).] F. J. W.

1016. New Method for Determination of Sorption Isothermals of Vapours on Charcoal. L. J. Burrage. *J. Phys. Chem.* 34. *pp.* 2202–2217, *Oct.*, 1930.—The retentivity test for the rapid evaluation of the vapour-sorbing properties of solid sorbents is further investigated, with reference to carbon tetrachloride and water vapours in charcoal, in order to ascertain how the concentration gradient in the charged charcoal column changes with the quantity of air passed. The experiments lead to a modification of the test so as to yield true sorption (or desorption) isothermals. The new method of determining sorption isothermals appears to be capable of general application to cases of sorption of vapours by solids. It is speedy, simple, accurate and flexible. The resulting sorption isothermals are discontinuous in nature, being made up of a series of loops cutting one another at definite pressures. A. J. M.

1017. Influence of Adsorbed Gas on the H.F. Resistance of a Platinum Wire. H. Dobretsberger. *Zeits. f. Physik*, 65. 5–6. *pp.* 334–357, 1930.—The existence of adsorbed layers of gases on solid surfaces has been demonstrated by their influence on the h.f. resistance. Adsorbed carbon dioxide, nitrogen and hydrogen increase the h.f. resistance of a platinum wire. The effect in the case of hydrogen is complicated by the existence of absorption as well as adsorption. F. J. W.

1018. Activation of Palladium and its Sorptive Power for the Rare Gases, Argon, Neon and Helium. M. E. Klarmann. *Zeits. f. Physik,* 65. 5–6. *pp.* 358–384, 1930.—It is shown that "activated" palladium [see Abstract 2030 (1930)] is able to sorb the rare gases argon, neon and helium. Further, the sorption is accompanied by an increase in the resistance of the metal. Thus, palladium after sorbing 319 times its own volume of argon, increased in resistance by 24 %; similarly, sorption of 446 volumes of neon caused an increase in resistance of 33 %. No quantitative results could be obtained with helium. F. J. W.

1019. Equilibrium Relations between a Plastic Crystalline Solid and Its Solution. B. Lockspeiser. *Faraday Soc., Trans.* 26. *pp.* 605–623, *Oct.,* 1930.—The equilibrium conditions of any system which may be subjected to small changes in either direction may be those of either reversible or irreversible change in a thermodynamic sense, experiment showing with which of these types the equilibrium conforms. Fluid systems exist in equilibrium under uniform conditions of hydrostatic pressure, and ample experimental evidence shows that physical and chemical transformations of such systems are thermodynamically reversible. With systems containing solids, the ability of the latter to withstand shear stress and the thermodynamic irreversibility of stress-strain changes in plastic solids introduce a new factor. It seems, therefore, desirable that other physical transformations of plastic solids, such as solution and evaporation, possibly involving uncontrollable stress changes, should be examined to ascertain whether they are thermodynamically reversible or irreversible. The results obtained with iodine in contact with its aqueous solution indicate thermodynamic irreversibility, since (1) the conditions of equilibrium at any particular temperature vary with the history of the system, (2) the form of the curve of approach from a displaced position towards equilibrium at a certain temperature is such that the equilibrium conditions cannot be those of thermodynamic reversibility, and (3) calculation of the molecular heat of solution (Q) on the assumption of thermodynamic reversibility indicates an inadmissibly high value for the temperature coefficient of Q. T. H. P.

1020. Structure of Celluloid. J. J. Trillat. *Comptes Rendus,* 191. *pp.* 654–656, *Oct.* 20, 1930.—Mixtures of cellulose nitrate and camphor containing 0–300 % camphor have been examined by X-rays, and the intermolecular spacings thus determined plotted against the percentage of camphor. These show at first a slow and then a more rapid increase from 4·5 Å. for pure cellulose nitrate to 6·1 Å. for liquid camphor. The results point to the formation of a definite compound able to dissolve excess of camphor. There is no indication of crystallisation. Pure cellulose nitrate shows orientation of the micelles, which gradually disappears with addition of camphor, the film becoming isotropic [see Abstract 2131 (1930)]. Other plasticisers show no sign of forming any compound with cellulose nitrate. C. A. S.

1021. Structure of Cellulose by Electron Diffraction. A. Dauvillier. *Comptes Rendus,* 191. *pp.* 708–711, *Oct.* 27, 1930.—In the course of experiments by de Broglie, the diffraction of electrons has been rendered visible on a fluorescent screen when such diffraction was effected by transmission through microcrystalline powders. The diagrams were photographed with exposures of the order of one second. The method is extended in the present paper to thin films of organic materials and is used for their structural analysis. This method is only applicable if the films are extremely thin and do not sensibly absorb the electrons but entirely preserve the electron charge. The results show the possibility of the method for analysis of colloidal or fibrous materials, electronic analysis of this character permitting the study of a single microcrystal. Illustrations are given for cellulose. S. G. B.

1022. Structure of Cellulose. K. Hess. *Kolloid. Zeits.* 53. *pp.* 61–75, *Oct.*, 1930.—A review of the history of X-ray analysis of cellulose structure. The article deals with the swelling and solution of cellulose filaments in aqueous alkalies, showing that in alkali-swollen filaments only two equatorial interference indications are present in the X-ray diagram, indicating a change in plasticity and the elastic properties. This point is dealt with at length. The work is extended to solution and swelling in organic liquids, and as an outcome of the results, methods are devised for estimation of the molecular size of cellulose. A comprehensive survey. S. G. B.

1023. Structure of Nitrated Cellulose. Part I. Swelling and Disintegration of Ramie Cellulose in Nitrating Acids. F. D. Miles and M. Milbourn. Part II. X-Ray Examination of Nitroramie. F. D. Miles and J. Craik. *J. Phys. Chem.* 34. *pp.* 2548–2620, *Oct.*, 1930.—The preparation of nitrated cotton fibre containing less than about 10 % of nitrogen by nitration in a mixture of sulphuric and nitric acids is liable to yield a disintegrated or parchmentised product. In preparation of nitrated ramie for X-ray work it was found impossible to obtain a product containing about 9 % of nitrogen which would retain the original fibrous structure, irrespective of the composition of the acid mixture. The present work is directed towards the preparation and examination of a series of cellulose nitrates containing less than 10·5 % of nitrogen. Little is known of their properties except of their extreme insolubility in all solvents, and their lack of homogeneity, based probably upon their disintegration, forms the chief theme of the present paper. It is found that the line which represents all mixtures which nitrate to 9 % of nitrogen lies wholly within the area of swelling. It is therefore probable that the observed physical changes are to be associated with some change in the structure of the nitrated fibre which becomes apparent when the nitrogen percentage reaches about 7·5. This change may be attributed to the swelling action of the constituents of the acid, which are believed to exhibit two separate tendencies, the sulphuric having a solvent action on the cellulose and the nitric the reverse. Finally it is shown that it is justifiable to associate the effects observed at nearly the same nitrogen percentage over a wide range of acid composition, with the attainment of a certain degree of nitration rather than with the use of acid mixtures of particular compositions. Experimental details and full discussion of results are appended. In Part II the examination is conducted into three classes of nitrocellulose, *viz.*, (1) those containing less than 7·5 % nitrogen, with unimpaired fibrous structure, insoluble in all solvents; (2) those containing from 7·5 % to 10·5 % nitrogen, showing a fibrous structure more or less destroyed and a tendency to dissolve in acetone; (3) those containing more than 10·5 % of nitrogen and including all technically important varieties. In class (1) the X-ray diagrams up to 7·5 % of nitrogen are identical or very similar to mercerised cellulose or their own denitration products. In class (2) the physical disintegration, etc., were discussed in the previous paper, and shown to be mainly dependent on the degree of nitration reached. At 10·3 % nitrogen a critical point is reached and the state of internal disorganisation is passed. In class (3) the nitration is intramicellar, and at 12·7 to 12·8 % of nitrogen there is discontinuity, and after this the comparatively definite trinitrate is reached. The whole progress is discussed step by step and experimental evidence given. S. G. B.

1024. Constitution of Cellulose Acetate and Nitrate and Transformation into Colloidal Film. J. J. Trillat. *J. de Physique et le Radium*, 1. *pp.* 340–350, *Oct.*, 1930.—An X-ray study of nitrated and acetated treatment of cotton according to the usual technique in order to obtain varying degrees of acidification. The products were examined in their ordinary form, and also as pilules formed by deposit from solution. It is shown that the nitrated cottons can be classified into several categories according to their degree of acidity. For high values the products are found to have a structure of a crystalline phase (chains of principal valencies) and also an amorphous phase. Then follows a category where the crystalline phase diminishes progressively with increase of amorphous phase until finally the latter exists alone, whereupon afterwards there appears the annular interference rings of the original cellulose itself. The nitrocellulose films have a structure little different from that of nitrated cotton, notably there are in the film intermolecular spaces which are greater than in the cotton, and the molecular disposition is more irregular. There is also a diminution in the size of the crystals of nitrated cotton passed to film form. The work of Hess and Trogus on the influence of solvents on such bodies is thus explained. Similar results are obtained with acetate both as homogeneous powder and as film. In this case, however, the fine structure of the film is the same as that of the acetated cotton, due to the acetation of the cotton in a homogeneous phase and thus passing it on to the collodion state. The results are applied to the identification of the several products studied. S. G. B.

1025. Constitution of Rubber. R. Pummerer. *Kolloid Zeits.* 53. *pp.* 75–78, *Oct.*, 1930.—A record of the results of chemical analysis and inquiry into the formula for rubber. It is shown that from experimental results of analysis the rubber formula can be expressed without a ring system. Either it lies within a very large closed ring of the isopentane group or in a long chain, in which the original isoprene group disappears in ring structure. The possibilities are fully discussed and a probable formula quoted. S. G. B.

1026. Colour and Size of Particles of Colloidal Silver, Particularly the New Hydrogen Peroxide Silver Sol. E. Wiegel. *Kolloid Zeits.* 53. *pp.* 96–101, *Oct.*, 1930.—Reference is made to the work of Carey Lea, Zsigmondy and Lüppo-Cramer. The author refers to his earlier work, pointing out that he discovered that hydrogen peroxide can be used as a reducing agent instead of the usual organic compounds for the preparation of strongly variegated colloidal silver having the desired properties [see Abstract 3271 (1930)]. According to the present investigation the particle sizes of variously coloured new systems as shown by transmitted light are given. The sizes are determined according to the usual application of the Zsigmondy immersion ultramicroscopic method. The results are discussed with reference to the theory of Mie. J. K.

1027. Microphotometric Study of Liesegang Rings. Suzanne Veil. *Comptes Rendus,* 191. *pp.* 611–612, *Oct.* 13, 1930.—Liesegang rings are produced by the action of silver nitrate on potassium bichromate in gelatin. The regions of maximum and least opacity are studied by a photoelectric cell according to the method of Lambert and Chalonge. Particular reference is made to the secondary rings discernible between the successive dark rings. J. K.

1028. Elastic Hysteresis of Aluminium and Its Alloys. G. Colonnetti and G. M. Pugno. *Pont. Accad. Sci., N. Lincei, Atti,* 14. *pp.* 435–488, 1930.—The elastic properties of the alloys of Al do not depend only on the chemical composition of the alloy but also, and perhaps more, on the thermal or mechanical treatment that the material has undergone. The following three properties which were noted in alloys of copper were found also in alloys of aluminium. (1) The irreversibility of the phenomenon of deformation. If a specimen is gradually subjected to a load increasing from zero to an arbitrary value and then the load is gradually decreased, the deformations observed on the original process are in general different from those in the reverse process. (2) The adjustment of the cycles. If the operation of loading and unloading is repeated a second time the deformations curve is different in the latter case from that in the first. (3) The modulus of elasticity assumes for each material a value practically constant immediately after every inversion of the sense of variation of the load. In some respects the characteristics of the alloys of Al differ from those of Cu. Whilst in the case of the Cu alloys examined the modulus of elasticity always assumed after every regression a maximum value, with numerous specimens of Al alloys the characteristic value of the modulus immediately after a regression was a minimum. Attention is called to the asymmetry of the bilateral cycles, that is, the diversity of the values that, other circumstances being equal, the modulus of elasticity can assume according as the experiment is with tension or compression. J. J. S.

1029. Deformation of Materials and Solidity. E. Schmid. *Phys. Zeits.* 31. *pp.* 892–896, *Oct.* 15, 1930. *Paper read before the Deut. Physikerlag., Königsberg, Sept.,* 1930.—The effects of work and deformation on the structure and properties of single crystal metals are discussed. The geometry and crystallography of the single crystal are considered, and the dynamics of crystal deformation are developed from the standpoint of plasticity. The considerations are applied to the technical many-crystal metals and the results compared with the structure obtained in the technical rolling operations. F. J. B.

1030. Tensile Strength and Cleavability of Bismuth and Antimony Crystals. G. Wassermann. *Zeits. f. Krist.* 75. 5–6. *pp.* 369–378, *Oct.,* 1930.—There is a critical normal tension of more than 680 gm./mm.^{2} for the rhombohedral rupture face of Bi crystals. Mechanical twinning of Bi and Sb crystals occurs readily on stressing. Mügge's data on the twinning elements are confirmed. The determination of normal tensions makes possible a quantitative comparison of the cleavability of crystallographically different faces. Extension of the investigation to crystals of a Bi-Sb solid solution has not been possible because of the difficulty of preparing homogeneous crystals. A. J. M.

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1031. Crystal Structure in the System Copper-Bismuth. W. F. Ehret and R. D. Fine. *Phil. Mag.* 10. *pp.* 551–558, *Oct.*, 1930.—As part of a programme to determine crystal structure in binary alloys in which one component is Cu, Ag, or Au and the other As, Sb, Bi or P, the structure of alloys of Cu and Bi was examined and is here reported. All the alloys examined were heterogeneous, showing clearly the superimposed diffraction patterns of Cu and Bi. Within the limits of our experimental error the lattices of Cu and Bi remain unchanged in their alloys. This is indicative of a very low mutual solubility. The lattice constant of the face-centred unit cube of Cu is redetermined, $a_0 = 3 \cdot 607 \pm 0 \cdot 004$ Å. This is in very close agreement with several recent determinations. Employing rhombohedral axes, mutually inclined at 57° 16′, the length of the edge of the elementary rhombohedron of the Bi structure is found to be $4 \cdot 749 \pm 0 \cdot 005$ Å. This is slightly higher than previously determined values. AUTHORS.

1032. Action of Etching Reagents on Metal Crystals with Reference to Crystal Structure. M. Straumanis. *Zeits. f. Krist.* 75. 5–6. *pp.* 430–448, *Oct.*, 1930.—Artificially prepared (polished) surfaces of a zinc single crystal which belong to the zones [0001], $[0001 \wedge \bar{1}0\bar{1}0]$, $[0001 \wedge \bar{1}2\bar{1}0]$ and $[0001 \wedge 25\bar{7}0]$ are etched in concentrated hydrochloric acid. Certain faces (true etch-surfaces) are dissolved in such a way that the faces remain parallel to their original positions. The principal etch-surfaces are (0001) and $(10\bar{1}0)$ and then those lying on the middle portions of the great circles on the stereographic projection which subtend an angle of 28° with the basal plane. The breaking down of all other surfaces which appear lustrous after etching (apparent etch-surfaces) results from the attack on true etch-planes, which appear as boundary faces in the etched structure on the surface. Etching effects in metals of the cubic system are much simpler, with generally only one true etch-plane. An optical polarisation method is described for determining whether, on etching, a surface has moved parallel to itself, whether new faces have formed on it or whether irregular attack has occurred. A. J. M.

1033. Diffusion of Metals in the Solid State. S. Tanaka and C. Matano. *Kyoto Coll. Sci., Mem.* 13. *pp.* 343–351, *Sept.*, 1930. *In English.*—The diffusion between gold and copper in the solid state was studied by using foils of many layers of the two metals made by alternate electroplating. Changes in electrical resistance caused by diffusion on heating the prepared samples in a vacuum furnace were measured and the formation of an alloy was confirmed by X-ray analysis. There was no formation of alloy at room temperatures. Diffusion was found to take place very slowly at 140° C. and became very strong at temperatures over 250° C. C. O. B.

1034. Coefficient of Diffusion of Metals in the Solid State. S. Tanaka and C. Matano. *Phys. Math. Soc. Japan, Proc.* 12. *pp.* 279–284, *Nov.*, 1930. *In English.*—The method described [see preceding Abstract] for the preparation of specimens was used with the metals gold and silver and changes in electrical resistance caused on heating to 500° C. were noted. It is concluded that the values determined for the coefficient of diffusion are nearly constant, *viz.*, $0 \cdot 99$ to $2 \cdot 34 \times 10^{-12}$ cm.²/min., with specimens showing considerable differences in thickness, indicating that Fick's law can be applied in this case. C. O. B.

1035. Molecular Constitution of Intermetallic Solid Solutions at Temperatures below that of the Eutectic Lead-Tin System. F. H. Jeffery. *Faraday Soc., Trans.* 26. *pp.* 587–590, *Oct.*, 1930.—The constitution of the solid solution of a metal Y in metal X where the dilute solid solution of Y in X throws out a dilute solid solution of X in Y on cooling from the eutectic temperature is treated thermodynamically. The equation $-\log n + \log (1 - n') = \lambda/R\theta + (\log K_{\theta_1} - \lambda/R\theta_1)$, where n is the molal fraction of Y in X and n' the molal fraction of X in Y, is deduced and applied to the solid solution of tin in lead. It is concluded that this solid solution consists of monatomic molecules of tin and of lead, so that for temperatures from the freezing point of lead down to 130° C. the solid solution remains of the same nature. [See Abstract 2684 (1930).] A. J. M.

1036. Action of Oxygen in the Corrosion of Iron and Steel in Aqueous Solution. H. Endo and S. Kanazawa. *Tohoku Univ., Sci. and Technol. Reports,* 19. *pp.* 425–435, *Oct.*, 1930. *In English. Report No.* 251 *from the Research Inst. for Iron, Steel and other Metals.*—Experiments were carried out to support the opinion that dissolved oxygen promotes the corrosion of iron and steel in aqueous solution and the effects of oxygen are enumerated. If a piece of iron be dipped in water, a minute quantity of it passes into solution as ferrous ion in a primary stage, which is accelerated by the formation of the concentration cell of the dissolved oxygen and this is due to the action of oxygen as a primary factor. When the ferrous ions are formed and an equivalent amount of hydrogen ions lose their electric charges, they are deposited on the surface of the metal as a thin film of free hydrogen gas and if oxygen be introduced into the above system, *i.e.*, in the secondary stage of corrosion, the oxidation of ferrous hydroxide to hydrated ferric oxide which is precipitated as rust and the removal of the hydrogen film from the metal surface by oxidation may take place and consequently the corrosion of iron is promoted by these actions of oxygen as a secondary factor. Various phenomena of corrosion of iron and steel are explained with these actions of dissolved oxygen as primary and secondary factors. AUTHORS.

1037. Electrochemical Behaviour of Metals. J. F. Chittum. *J. Phys. Chem.* 34. *pp.* 2267–2285, *Oct.*, 1930.—The general question of corrosion phenomena is discussed and the difficulties involved in their explanation by means of the several theories are pointed out. The lack of an explanation of passive iron is shown to be the greatest difficulty confronting the electrochemical theory. The interpretation of the variation of the potential of metallic iron with the pH value of the solution in which the iron was dipped, makes the explanation of passive iron possible. A number of principles are pointed out which govern the electrochemical behaviour of iron. These principles are applied to the corrosion of iron and enable a mechanism of corrosion to be propounded. F. J. B.

1038. Geometrical Inversion in Light. B. K. Vaidya. *Roy. Soc., Proc.* 129. *pp.* 299–313, *Oct.* 1, 1930.—Quantum efficiency determinations are made for the inversion in ultra-violet light of the geometrical isomers: maleic and fumaric acids, citraconic and mesaconic acids, coumaric acid (trans and cis), cinnamic and isocinnamic acids, with the mean respective results of 0·048, 0·117, 0·182, 0·030, 0·609 and 0·206, for the wave-length $313\mu\mu$, subject to slight variations depending on the concentration of the solution. It is suggested that in substances showing selective absorption the quantum efficiency value would approach unity as the exciting radiation decreases in wave-length within one of the photochemically active bands. In the present work substances showing general absorption or those in which the exciting radiation fails to fall within an active band appear to have a low quantum efficiency. Possible reasons for the inactivity of mesaconic and crotonic acid are discussed.

A. J. M.

1039. Motion of Flames in Closed Vessels. C. W. Stephenson. *Faraday Soc., Trans.* 26. *pp.* 577–587, *Oct.*, 1930.—A mathematical treatment confirming the conclusions of Ellis [see Abstract 1365 (1929)] on flame movement in gaseous explosive mixtures, namely, the speed of the flame, shows a maximum change at the moment when the volume of the burnt gas equals the volume of the unburnt gas; when the ignition is eccentric the flames tend to become concentric with the vessel; when there is multiple ignition, each flame spreads as if confined to an isolated region of the vessel; the velocity of the gas on one side of the surface of a flame differs in sign and quantity from the velocity of the gas on the other side. A. J. M.

1040. Absolute Amount of Radiant Heat Emitted during Gaseous Explosions. D. A. Hall and K. Tawada. *Faraday Soc., Trans.* 26. *pp.* 600–605, *Oct.*, 1930.—The fraction of the heat of combustion emitted as radiation from a flame largely depends on experimental conditions. The present work is experimental in character and adopts the method due to Johnson, using a narrow cylindrical bomb 2·5 cm. internal diameter and 32 cm. long fitted with a fluorite window for CO/O explosions and quartz for H/O reactions. The modifications included the substitution of a Hefner lamp as a standard source of light and a circular thermopile in place of a linear one originally used. Garner and Roffey's method for recording results was adopted, the values being assessed by calibration with a "control" curve. Results showed that 2·83 % of the heat of combustion is radiated through the quartz window during the H/O explosion and 23·9 % through a fluorite window during the explosion of a "dry" mixture of CO and O. The latter result confirms the indirectly obtained value of Garner and Roffey. The large increase in the radiation (from 2·3 % to 23·94 %) obtained by drying the reacting gases (*i.e.*, CO and O) is probably due to chemiluminescence. S. G. B.

1041. Ignition of Detonating Gas by Quartz or Porcelain at Reduced Pressures. H. N. Alyea and F. Haber. *Zeits. f. phys. Chem.* 10. *Abt. B.* 3. *pp.* 193–204, *Oct.*, 1930.—When streams of hydrogen and oxygen cross each other at temperatures of 435° to 540° C. and pressures of 10 mm. to 200 mm. Hg., no ignition occurs in the free gas space, but, at surfaces of quartz, porcelain and glass, spontaneous explosion takes place between definite pressure limits. Aluminium surfaces are found to be inactive and so enable the mechanism of the explosion processes to be studied. By allowing a stream of detonating gas and oxygen, and of detonating gas and hydrogen to pass through porcelain tubes under reduced pressures, it is shown that hydrogen gas favours quiet combination at the surface with reduction of explosivity effect, whilst oxygen has the reverse effect. Full experimental details are included. H. H. Ho.

1042. Detonating Gas Photolysis. E. Baur. *Zeits. f. wiss. Phot.* 29. 1–12. *pp.* 163–167, 1930.—The paper commences with a discussion of photo-effects on electrode potentials and, based on the author's photolysis theory, comes to the conclusion that detonating gas photolysis should take place in the eosine system employed in these experiments. Although only negative results were recorded for the eosine system, success was obtained with a system containing chlorophyll. H. H. Ho.

1043. Radiation Influence upon the Combustion of Colloidal Powders in a Closed Vessel. H. Muraour. *Comptes Rendus*, 191. *pp.* 713–715, *Oct.* 27, 1930.—Previous work in this field has shown that at high densities, the area of the pressure-time curve ($\int p\,dt$) is practically constant but that at low densities this area diminishes considerably and may fall below half its previous value. The explanatory hypothesis involved either a variation of the temperature of the gaseous layer which heats the powder or by supplementary energy from the calorific radiation of the gas. To test the latter hypothesis, various special gun cottons have been combusted, and from the data obtained the conclusion is drawn that the radiation hypothesis is insufficient to account for the above diminution in area. H. H. Ho.

1044. Gaseous Combination in Electric Discharges. Part V. Spectrographic Examination of the Kathodic Combustion of Carbonic Oxide. G. I. Finch and H. H. Thompson. *Roy. Soc., Proc.* 129. *pp.* 314–319, *Oct.* 1, 1930.—Direct-current discharges traversing "detonating gas" and various other gases under experimental conditions described previously [see Abstract 1230 (1930)] have been spectrographed. The spectra show that under these conditions CO molecules are excited but not ionised; the CO-bands in "detonating gas" are superposed on a faint continuous background; metals are sputtered as atoms; and in pure oxygen positively charged oxygen molecule and atom ions and neutral oxygen atoms are formed; in all probability oxygen atoms are also formed in "detonating gas." The non-ionisation of CO in these experiments proves that kathodic combustion of CO "detonating gas" is not determined by a prior ionisation of the CO. A. J. M.

1045. Organic Reactions in Gaseous Electrical Discharge. Part I. Normal Paraffin Hydrocarbons. E. G. Linder. *Phys. Rev.* 36. *pp.* 1375–1385, *Oct.* 15, 1930.—An apparatus is described for subjecting vapours to an electrical discharge. Vapour pressure and current are variable. Different fractions of the gaseous reaction products can be collected and their rates of accumulation measured. A study of n-decane vapour with this apparatus, with current values of from 0·5 to 2·5 mA., voltage approximately 450 volts, and pressures from 0·2 to 4·5 mm. of mercury, indicates that electric conduction in gases may follow an electrochemical equivalence law similar to Faraday's law of electrolytic conduction in liquids. Evidence has been obtained showing the amount of reaction to be proportional to the current, and independent of voltage and vapour pressure. Among the reaction products is a wax-like substance which deposits on the kathode only. The rate of production of gaesous reaction products has been measured for various values of discharge currents and vapour pressure. Curves and tables are given showing the relation between molecular size and rate of production of various fractions of the gaseous reaction products, for a series of seven normal paraffin hydrocarbons. A brief theoretical discussion is given. AUTHOR.

1046. Combination of Nitrogen and Hydrogen Activated by Electrons. G. F. Brett. *Roy. Soc., Proc.* 129. *pp.* 319–327, *Oct.* 1, 1930.—The velocity of the reaction between nitrogen and hydrogen activated by electrons has been determined as a function of the electron speed by measurement with a Pirani gauge of the rate of change of pressure produced by freezing out the reaction product. Sharper breaks than those observed by Caress and Rideal [see Abstract 3221 (1927)] are obtained by employing a coated platinum foil filament of relatively large surface area, whereby the potential drop along the filament is considerably reduced. The reaction velocity curves show breaks at 17·0, 18·5, 20·5, 24·5 and 27 volts, corresponding with the production of N_2^+, $H + H^+$, $N_2^{+\prime}$, $N' + N^+$ and metastable excited nitrogen and/or atomic hydrogen, respectively. At electron speeds below the ionisation potential of nitrogen the reaction velocity is small, since the two excited states at 13·0 and 14·8 volts are not metastable. The mechanism of the reaction involves most probably the combination of atomic hydrogen with nitrogen in an active state. H. F. G.

1047. Doubly-Charged Positive Molecules in Canal Rays. R. Conrad. *Phys. Zeits.* 31. *pp.* 888–892, *Oct.* 15, 1930. *Paper read before the Deut. Physikertag., Königsberg, Sept.*, 1930.—A description is given of a new apparatus for obtaining particularly sharp canal-ray parabolæ. By means of this apparatus the existence of doubly charged positive molecules of the following substances was established: CH, CH_3, C_2, C_2H, C_2H_2, C_2H_3, C_2H_4, CO, O_2, C_2O and CO_2. From these results it is clear that the assumption of the non-existence of doubly-charged molecules in canal rays is no longer tenable. In addition, evidence was obtained of the existence of Cl atoms with at least five positive charges. With helium filling the discharge tube the effect of the strong electron affinity of chlorine is shown in the production of a strong line corresponding to He^{++}. [See also Abstracts 447 (1921) and 664 (1931).] A. W.

1048. Molecular Ray Experiments. Chemical Activity of Molecular and Atomic Oxygen. W. H. Rodebush and W. A. Nichols, Jr. *Am. Chem. Soc., J.* 52. *pp.* 3864–3869, *Oct.*, 1930.—The initial purpose of this investigation was to find some chemical reaction by which the image of a beam of oxygen molecules could be formed on a target for a Stern-Gerlach experiment. An exhaustive search has failed to discover any surface with which a beam of oxygen molecules will react to give a visible image. A beam of oxygen atoms appears to give the same reaction with molybdenum trioxide as a beam of atomic hydrogen, and is believed to be represented by the equation: $3MoO_3 + O = Mo_3O_8 + O_2$. H. H. Ho.

1049. Resonance and Physico-Chemical Periodic Phenomena. N. v. Raschevsky. *Zeits. f. Physik,* 65. 3–4. *pp.* 270–272, 1930.—Rhythmic physico-chemical reactions are known to occur [see Abstract 1005 (1929)]. Here the possibility is considered of two such reactions of closely similar period giving rise to a resonance effect which could lead to a considerable influence of one upon the other. The writer concludes that such a resonance effect is possible and gives the conditions. A. C. M.

1050. Influence of Grain Size on Dissociation Pressure of Solid Bodies: Red Mercuric Oxide and Iceland Spar. J. Krustinsons. *Zeits. f. phys. Chem.* 150. *Abt. A.* 3–4. *pp.* 310–316, *Oct.*, 1930.—Progressive reductions of the grain size of mercuric oxide and Iceland spar are accompanied by corresponding decreases in the dissociation temperatures; thus the pressure over mercuric oxide at 377° C. is reduced from 790 mm. to 508 mm., by an increase in particle diameter from 20μ to $113{\cdot}4\mu$. Assuming Thomson's formula relating surface tension, vapour pressure and particle size to hold for equilibrium at solid-gas boundaries, the surface tension of red mercuric oxide is calculated to be 750,000 dynes/cm., and of Iceland spar 120,000 dynes/cm. The view of Valeton, that the surface tension of crystals of diameter greater than 2μ has no important effect on the equilibrium between these crystals and their saturated solutions, cannot be applied to the thermal dissociation pressure. A. J. M.

1051. Gaseous Glow in Heterogeneous Reactions. W. Frankenburger and W. Zimmermann. *Zeits. f. phys. Chem.* 10. *Abt. B.* 3. *pp.* 238–240, *Oct.*, 1930.—The recent publication of Frommer and Polanyi [see Abstract 2354 (1930)] concerning the luminescent effect produced by the action of Cl_2 upon Al in the presence of Cu, has induced the present authors to describe some experiments made several years ago on the very similar phenomena observed during the treatment of lithium nitride with nitrogen containing oxygen. Several photographs and diagrams are included. H. H. Ho.

1052. Kinetics of Gaseous Oxidation Reactions. R. Fort and C. N. Hinshelwood. *Roy. Soc., Proc.* 129. *pp.* 284–299, *Oct.* 1, 1930.—The peculiarities associated with gaseous oxidation reactions, such as that of ethylene or of benzene have been further investigated [see also Abstracts 850 and 3280 (1930)] with a view to discovering the part played by chemical configuration in determining the kinetics of the oxidation. The substances studied were methane, methyl alcohol and formaldehyde, the two latter being intermediate products in the oxidation of the former. The following characteristics were common to all the reactions: an initial induction period, most pronounced with methane; the striking dependence of the rate of reaction on the concentration of the combustible gas, and the relatively small influence of oxygen concentration; the marked decrease in the rate of reaction in vessels of small dimensions. These characteristics are best explained by assuming that the reactions occur by "chain" mechanism. The operation of this mechanism does not seem to depend upon any particular chemical configuration of the reacting molecules, as long as the necessary energy is available. The relation between rate and the dimensions of the vessel has been studied in detail for methyl alcohol, in the oxidation of which the chains appear to end only at the wall of the vessel, in contrast with the case of benzene where they end principally in the gas unless the vessel is very small. The part played by the walls depends not only on the dimensions of the vessel but on the nature of the surface. It seems probable that the adsorbed layer of oxygen may play an important part in breaking the chains which reach the wall. A theory based upon these assumptions gives results in general agreement with experiment. AUTHORS.

1053. Effect of X-Radiation on a Platinum Catalyst in the Synthesis of Water. P. H. Emmett and E. J. Jones. *J. Phys. Chem.* 34. *pp.* 1102–1104, *May*, 1930.—Hydrogen-oxygen mixtures containing 97·2 % oxygen and 2·8 % of hydrogen were allowed to stream over a platinised asbestos catalyst at room temperatures. It was found that irradiation of the catalyst with X-rays was without effect on its activity. F. J. W.

1054. Heat of Combustion of Salicylic Acid. P. E. Verkade and Y. Coops, Jr. *J. Phys. Chem.* 34. *pp.* 2549–2553, *Oct.*, 1930.—The paper forms a reply to the paper of Keffler [see Abstract 1908 (1929)]. The various results obtained by different workers for the heat of combustion of salicylic acid are discussed, and its suitability as a secondary thermochemical standard is discussed. It is pointed out that the correction of the authors' experimental data proposed by Keffler is not justifiable. It is considered that salicylic acid, with a heat of combustion of 5241·3 cals., is in every way a suitable secondary thermochemical standard. F. J. B.

1055. Heat of Formation of Molecular Oxygen. L. C. Copeland. *Phys. Rev.* 36. *pp.* 1221–1231, *Oct.* 1, 1930.—An apparatus has been constructed and described for the production of atomic oxygen and the direct determination of the heat of formation of molecular oxygen. A series of determinations have been conducted in the pressure range of 0·1 to 0·55 mm. of mercury. The heat of formation of molecular oxygen was determined by these experiments as 131,000 (± 6000) calories or 5·7 (± 0·3) volts per gram molecular weight. Several of the properties of atomic oxygen have been investigated, including the possibility of long-lived metastable states. AUTHOR.

1056. Heats of Dissociation from Predissociation Spectra. Heat of Dissociation of Oxygen. G. Herzberg. *Zeits. f. phys. Chem.* 10. *Abt. B.* 3. *pp.* 189–192, *Oct.*, 1930.—The discrepancy between the heat of dissociation of oxygen derived from the predissociation spectra of NO_2 and SO_2, and from analysis of the atomic oxygen spectrum, results from the long wave-length limit of the diffuse region of the band series representing not the commencement of the continuous term spectrum but a molecular dissociation accompanied by a considerable change of kinetic energy. Frerich's value of the heat of dissociation of oxygen (5·09 volts) is therefore correct, and the work of separation of the first oxygen atom from nitrogen peroxide is 3·1 volts. The long wave-length limits of predissociation spectra yield only the upper limits of heats of dissociation. H. F. G.

1057. Interaction of Molecules with the Silver Ion. F. K. V. Koch. *Phil. Mag.* 10. *pp.* 559–564, *Oct.*, 1930.—Fajans has concluded [see Abstract 452 (1929)] that the transition from an electrovalent to a covalent linkage is continuous, and that the covalent band may be regarded as having its origin in the extreme mutual deformation of the electron orbits of the constituent ions. A parallelism may be predicted for the interaction of ions and molecules and for this purpose a comparison of the free energies of solvation of an ion determined experimentally has been made with the calculated values. Data are recorded for the silver ion in ten organic liquids which show that the transition from solvation to complex formation is gradual, and which are in good agreement with the well-known chemical properties of the silver ion. H. H. H.

1058. Electrolytic Peltier Heats and their Measurement by Isothermal-Adiabatic Differential Calorimetry. E. Lange and J. Monheim. *Zeits. f. phys. Chem.* 150. *Abt. A.* 3–4. *pp.* 177–202, *Oct.*, 1930.—Electroltyic Peltier heats at reversible electrodes are discussed in relation to other thermodynamic magnitudes of the galvanic cell. Previous measurements are considered. In the method of measurement now applied use is made of an isothermal-adiabatic differential calorimeter and of the Hg/Hg_2^{++} electrode, the mercury electrodes being employed in mercurous nitrate solutions of various concentrations and the normal calomel electrode also being used. In agreement with the conditional theoretical deductions, the values found for the electrolytic Peltier heat become increasingly positive as the concentration of metallic ions increases. [See Abstract 3776 (1930).] T. H. P.

1059. Theory of Hydrogen Overpotential. T. Erdey-Grúz and M. Volmer. *Zeits. f. phys. Chem.* 150. *Abt. A.* 3–4. *pp.* 203–213, *Oct.*, 1930.—In order to develop H at a metal electrode there is necessary under certain circumstances a much more negative electrode potential than that of the reversible H electrode. The overpotential, *i.e.*, the difference between that actually existing with H development and the reversible electrode potential, is dependent upon various factors. This overpotential, η, has been expressed by Tafel in the equation $\eta = a - b \log J$, where a and b are magnitudes independent of the current density J. From the existing experimental material it is shown that during the production of the overpotential so long as no H development takes place the H ions produced by the current at the electrode do not in appreciable amount discharge but are simply arranged in the double layer. On this basis a theory is developed which correctly yields the absolute value of the constant $b = d\eta/d \log J = 0{\cdot}116$ of Tafel's equation, its dependence on temperature and the falling off of the overpotential after interruption of the electrolysis. [See Abstract 2052 (1930).] J. J. S.

1060. Platinum-Hydrogen Electrode. M. Thalinger and M. Volmer. *Zeits. f. phys. Chem.* 150. *Abt. A.* 5–6. *pp.* 401–417, *Oct.*, 1930.—When a platinum electrode in hydrogen was anodically polarised, it exhibited passivity. The behaviour was similar to passive electrodes of iron, chromium, nickel, etc., except for one minor difference, that the passive state was not due to the passage of metal ions into solution but had its origin in the hydrogen ions. The passive state appeared to be a " poisoning " of the platinum catalyst for the reaction $H_2 \rightarrow 2H$. The " poisoning " is caused by the oxygen, and a layer one atom thick sufficed. As the polarisation progressed the layer became thicker and its stability increased. F. J. B.

1061. Electrocapillarity. Parts I and II. J. A. V. Butler and C. Ockrent. *J. Phys. Chem.* 34. *pp.* 2286–2306, *Oct.*, 1930.—The electrocapillary curves of a number of organic acids and their salts were determined in M/2 sodium sulphate, and also of a number of solutions containing two active substances. The maximum adsorption of salts of weak acids occurred at a potential difference of about 0·1 volt more positive than for the weak acids. The electrocapillary viscosity shown by solutions of the acids appears to be due to the formation of alkali in the solution owing to the discharge of hydrogen ions at the mercury surface. It is shown that in a mixture of substances of the same type (ions or non-ionised molecules), if one compound causes a greater lowering of surface tension than the other over the whole range of potential differences, it alone is adsorbed. When the components cause the same lowering of surface tension, both substances are adsorbed from the solution. F. J. B.

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SCIENCE ABSTRACTS.

Section A.—PHYSICS.

ERRATA

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tract No. 82, lines 9, 13 and 15: *for* Plejaden and Hyaden *read* Pleiades and Hyades; *for* width *read* latitude.

stract No. 127, line 3: *delete* of *after* spectrum;

ditto , line 4: *read* value *for* limit;

ditto , line 5: *for* is therefore a $^3P_2$-term. This $^3P_2$-term can also assume *read* is a new $3\,^3P_2$-term. This $3\,^3P_2$-term can therefore assume.

stract No. 375, line 3: *for* terror *read* tensor.

stract No. 534, lines 7 and 8: *read* and so far as differences in the model do not introduce changes, it also agrees with.

1064. Apparatus for Experimenting with Gases at High Pressures up to 6000 Kg. per Sq. Cm. J. Basset. *Comptes Rendus,* 191. *pp.* 928–931, *Nov.* 17, 1930.—In the first apparatus described one or more gases can be continuously introduced at high pressure into a reaction chamber which is heated electrically. It is proposed to experiment with a similar apparatus with which a pressure of 10,000 kg. per sq. cm. can be obtained. Another one for studying the compressibility of gases at high pressures is described. The gas is introduced under pressure into a strong steel tube into which fits a piston. This piston is attached in line to another piston of much greater area, and is pushed into the gas tube by liquid pressure acting on the surface of the second piston. The resulting movement can be observed on a vernier, and the pressure in the gas can be calculated from the liquid pressure measured by an ordinary manometer. H. N. A.

1065. Clarity of Expressions in Technical Writings. A. Schack. *Zeits. f. techn. Physik,* 11. 12. *pp.* 547–549, 1930.—A reasoned plea for the exact statement of definitions and units in quoting general formulæ. It is pointed out that dimensionless formulæ may be misleading if, for example, density and specific gravity are not carefully distinguished from each other. J. H. A.

1066. Fitting Observations to a Curve. N. Campbell. *Phil. Mag.* 10. *pp.* 745–758, *Nov.,* 1930.—The simplified method of curve-fitting described by Condon, Birge and Shea, based on the method of least squares, now applied use is made of an isothermal-adiabatic differential calorimeter and of the Hg/Hg_2^{++} electrode, the mercury electrodes being employed in mercurous nitrate solutions of various concentrations and the normal calomel electrode also being used. In agreement with the conditional theoretical deductions, the values found for the electrolytic Peltier heat become increasingly positive as the concentration of metallic ions increases. [See Abstract 3776 (1930).] T. H. P.

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